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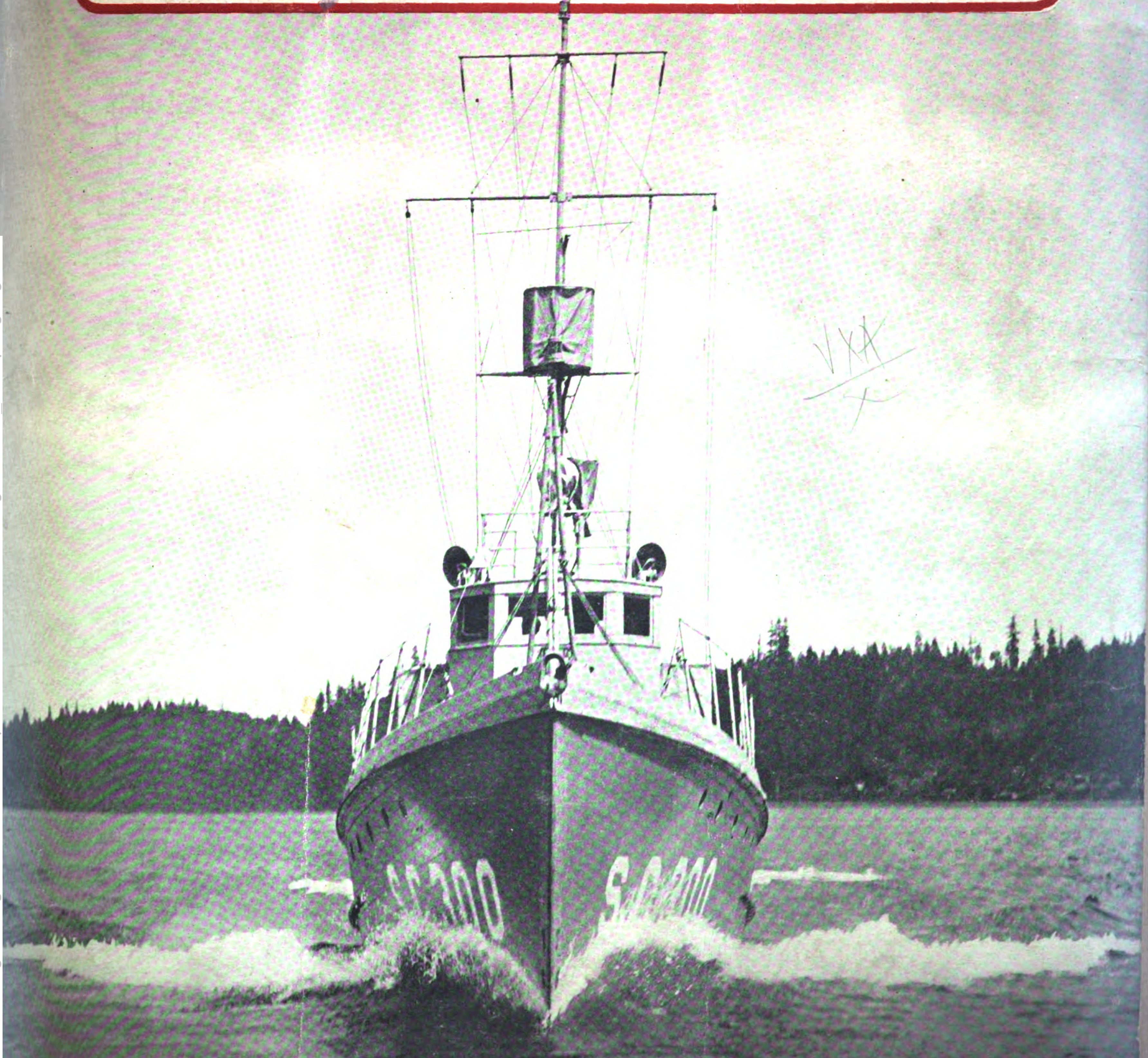
MOTORSHIP

Devoted to Commercial and Naval Motor Craft

SEATTLE | NEW YORK | June, 1918



One of the new 110-foot Submarine Chasers
Built for the United States Navy

MOTORSHIP

Trade Mark, Registered

South Ferry Building
NEW YORK, N. Y.

L. C. Smith Building
SEATTLE, WASH.

PUBLISHED MONTHLY IN THE INTEREST OF COMMERCIAL AND NAVAL MOTOR VESSELS AND FOR RECORDING PROGRESS OF THE MARINE INTERNAL-COMBUSTION-ENGINE

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June, 1918 Vol. 3 No. 6

LEADING EDITORIAL CONTENTS

PRINCIPAL ILLUSTRATIONS

EDITORIAL

The oil-engined motorship is such a pronounced economy that it must come. Nothing can stop it! And all obstacles will be removed as fast as they arise. The law of progress will see to that. Very strong prejudices stood in the way of steam. But, one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by the economical internal-combustion power. America, the most important oil-producing country, will be the greatest motorship-owing nation. Let us all assist to make that day soon!

THE GERMAN NAVAL POLICY.

WHAT is the meaning of the strange, ominous silence of the German surface navy? Why is Germany holding back her grand fleet? Why has Germany added to her battle-cruiser squadrons during the war? * * * Germany obviously is holding back her fleet for a final and "awe-inspiring" feat—and, it will not be a foolhardy attack on the British or allied grand fleet, unless intercepted in its dash for the open ocean.

To those who can read between the lines there is every indication that Germany has a last desperate scheme up her sleeve. If the submarine menace is more than substantially checked, undoubtedly Germany will depend upon her mine-fields, submarines and powerful land-forts to hold back the Allied navies from her shores as she is now doing and so be safe from invasion with her fleet at sea. Before the war is over her entire navy may make a bold dash for the open sea, and then disperse to all parts of the world, and endeavor to sink all merchant ships on sight, until all her warships are sunk or captured. It would take many months and even over a year to separately capture all her warships, which would keep the seas on fuel and food taken from the captured freighters. We can depend Germany realizes that, as a last resource, this will be better than engaging in a hopeless "grand battle" with the Allied fleet.

This possibility the Allies must take every precaution to prevent, and be ready to meet if it does come. No chances must be taken and we must be fully prepared for such an eventuality. With two or three million American troops in France a year from now depending upon the transatlantic services for food, munitions, gasoline, oil, and other supplies, such a situation would be most critical, and may even pass the terms of peace into Germany's hands, at a time when she was otherwise beaten to a frazzle. Possibly our surmise is all wrong! Perhaps it is; but, nevertheless it is a possibility that cannot be overlooked or disregarded. Not a single risk can be taken. We cannot afford it. Too much is at stake.

True, the British fleet is keeping itself intact to prevent such a dash, and possibly the American fleet may be sharing that honor, so, doubtless, many German ships would be sunk; but the majority may escape because they would disperse in all directions, which the Allied fleets dare not do. Obviously Germany would take advantage of a dark night or foggy weather to get as far as possible up the North Sea without being seen, and when sighted, and intercepted, would hold up her heavier armed battleships to bear the brunt of the Allied attack, whilst the faster battle-cruisers, destroyers and scout-cruisers dashed for the open Atlantic. Whether they could get by the Allied minefields and grand fleet is quite another matter, as the stretch of the North Sea which they would have to pass would be over 24 hours' run at full speed, giving the British fleet some little time to do deadly work, unless, of course, Germany has doubled or trebled the engine-power of her fleet in order to give them a speed supremacy, and thus aid this dash. She has had four years in which to do this, and thus it is unreasonable to assume that she has not in some way improved the fighting value of existing war-craft.

If by any possible chance Germany succeeds in breaking through,—and we are not unmindful of the various raids she has made across the North Sea—it will be vitally serious for the Allies, because the task of hunting the individual enemy ships would be slow work. While the German raiders were at sea the damage done doubtless would far exceed that done by submarines, as indicated by the remarkable work of the solitary raiders "Emden," "Moewe," "Prinz Eitel Friedrich" and "Seeadler" and because they would be able to attack convoyed merchant fleets. Thus, we can imagine the results of a hundred German warships distributed all over the world's seas, and the terrible effect on commerce. Not knowing when or where the German fleet would reassemble at a predetermined time the Allied fleets could not search the oceans, except in strong squadrons, which would lengthen out the task. Let us also remember that it took over a year for the British to destroy Admiral Von Spee's fleet at the now-famous Falkland battle. In such an event, one can easily anticipate the great value of a large number of motor-vessels that can cross the ocean with cargoes, without any betraying coal-smoke to render them an easy prey to the raiders.

GEARED-TURBINE SHIPS.

From conversations we have had with shipping men who should know, the geared-turbine drive has not by any means been the complete success expected, and that considerable trouble has been experienced with the gears, several new American ships having been laid up for one to three months from this cause. However, this is no inference that it will not be successful eventually, as all new types of marine machinery can only be developed by sheer experience, under ordinary sea-going conditions. In the past motorships have been "through the mill" and even at the present time several new designs of marine oil-engines are passing through their most critical period.

THREE OF THE AMERICAN-BUILT STANDARD GASOLINE-ENGINED 80-FOOT PATROL BOATS OF THE BRITISH NAVY

Motorcraft and War Work

The Great Value of Motor-Boats for Patrol Duty and Other Very Important Naval Work

TRULY this great conflict may be correctly termed "an internal-combustion-engine war;" for its use has been remarkably valuable in all directions including transportation, defense, and attack. Without the motor the scale of operations of the Allies and their foes could not have been carried out in anything like the enormous extent that it has been. Tanks, airships, aeroplanes, sea-planes, big guns, trucks, tractors, staff-automobiles, motorcycles for scouting, monitors, submarines, submarine-chasers, convoy-craft, patrol-boats, scouts, fleet service-craft, navy-yard boats, trench lighting and pumping sets, etc., all have required internal-combustion-engines of various types in huge numbers.

Particularly in the various navies have the duties of motorcraft proved multifarious, and this may be said especially of those of the smaller type (50-100 ft.) including converted gasoline-engined pleasure-craft of substantial design and construction, which have been of the greatest value for patroling the waters within about a hundred miles of the U. S. and Allied coasts—and occasionally further out at sea—thus relieving the T. B. destroyers of a certain amount of essential work and police duties, and so leaving the destroyers free for convoy work or to remain further out at sea in search of the large ocean-going submarines, where they are most needed.

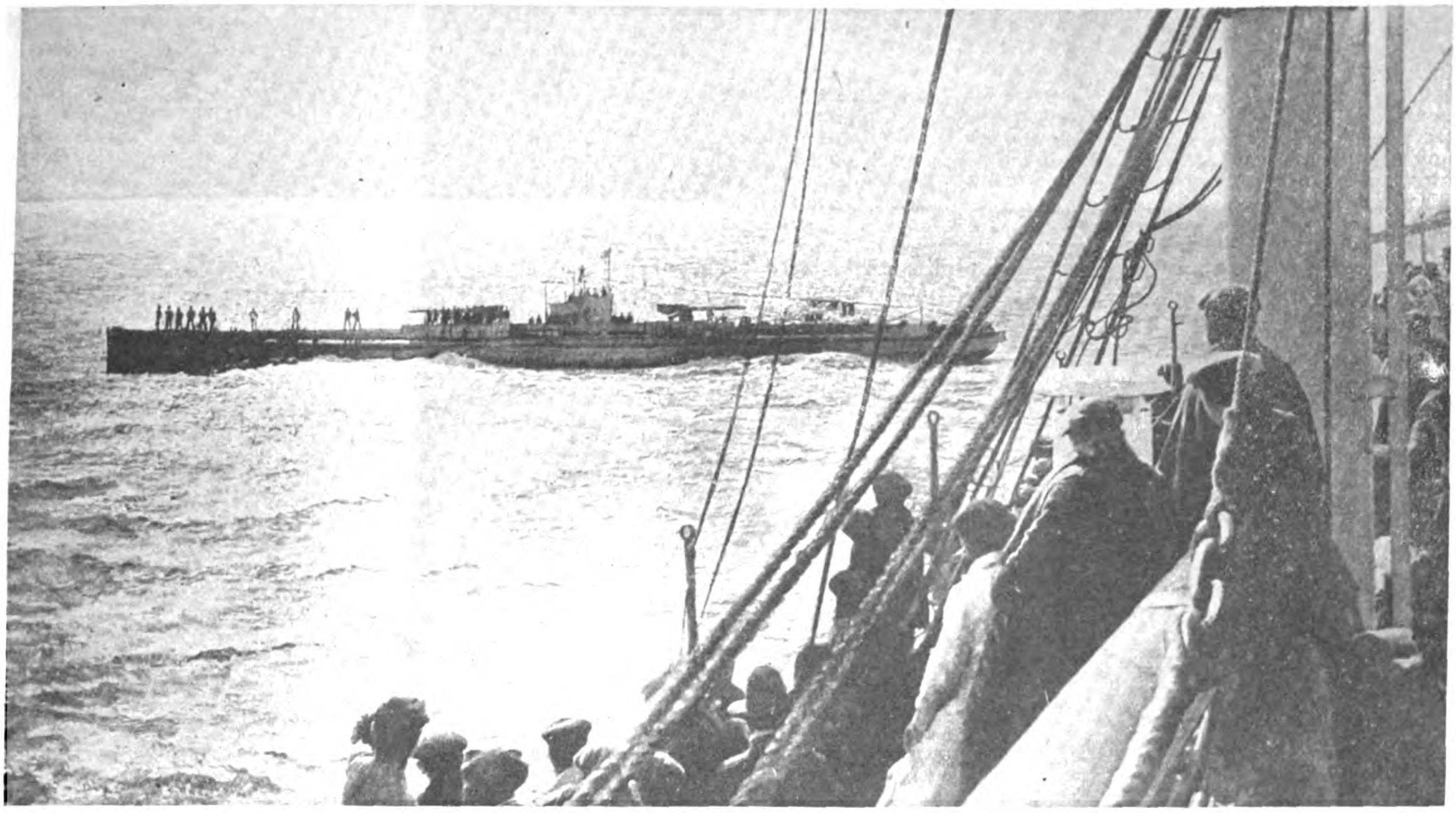
In some circles we have been freely criticised for having persistently advocated a large type of motorcraft (135 to 200 ft.) for ocean-going submarine destroying, and in several instances our expressions have been misconstrued. In the early days of America's entry into the war nearly every patriotic man who owned a little motorboat or cabin cruiser, and many others (including some of the motor-boating and yachting magazines) became honestly convinced that his boat was ideal for "submarine swatting" and that it would be fine sport hunting German submarines if a one-pounder gun was attached on the forward deck of his boat. Also that it was a simple matter to sink a submarine, provided one saw her first and "got home" with a direct hit.

Possibly these well-meaning men did not realize at that time that Germany anticipated considerable activity against her U-boats and that the decks of her submarines consequently are fairly heavily armored, and that even with the conning-tower almost literally shot to pieces a U-boat still can submerge and seek safety under water. Or that if the U-boat prefers to stay on the surface, she probably could, with her two or more 5" guns, blow up half-a-dozen 50-ft. wooden cabin-cruisers in as many minutes even if the boats were of 25-knots speed, and very likely would hardly suffer any serious damage herself. Unfortunately, some of the motorboating papers encouraged this mistaken belief regarding amateur "submarine-swatting"; which no doubt sounded very fascinating; but, "Motorship" took immediate steps to enlighten its readers as to what the real duties of such motor-craft were, and as to how valuable they would be to the Navy in their proper sphere. (See "Motorship" page 17, April, 1917, also previous and subsequent issues).

"S. P. 909." THIS VESSEL AND HER SISTER, "S. P. 908," CONDUCT STEAMERS THROUGH THE CHANNELS AND MINE FIELDS IN THE SECOND NAVAL DISTRICT

This action on the part of "Motorship" really was necessary because the existence of thousands of such craft in home waters was causing a tendency to place too much confidence in their capabilities, and that the placing of extensive orders under the circumstances by the Navy Department might have caused a storm of public protest **"when there were so many fine pleasure craft that could be converted into submarine-swatters."** (sic) Thus we foresaw the danger in the possibility of larger and properly designed motor-vessels not being built for this urgent work in time to meet the increased submarine activity that we expected, and so we urged upon the authorities to specially build large oil-engined boats of sufficient size, not only to be able to remain in mid-ocean in really heavy weather, (which even small boats can do provided the crew can stand a certain amount of hardship and discomfort); but, to be able to fight a submarine on the surface in a rough sea when necessary; also to allow of the crew working in "comparative comfort." This we saw was important, because at the time we had reason to believe that Germany was constructing larger and heavier-armoured submarines which could and would operate 200, 400, 500 and 1,000 miles off the coast, and as it happened we were correct; although after their first appearance these submersibles, it was reported, had to be re-built because of faulty design and structural weaknesses, etc., and only recently have been making their reappearance.

Because we strongly have urged the necessity of large oil-engined patrol-boats, or submarine-destroyers, we certainly did not infer that small gasoline-engined boats should not be built too; but, that it was more important to construct larger vessels. In fact, in our issue of May, 1917, on page 3, we said that—**"there is no doubt that the United States must build motorboats by the hundred and even thousands, boats of 50, 60, 70, 80, 90 110 ft. and so on up to 150 ft., for there is important work for all sizes, each class being as important as any other in its respective duties."**



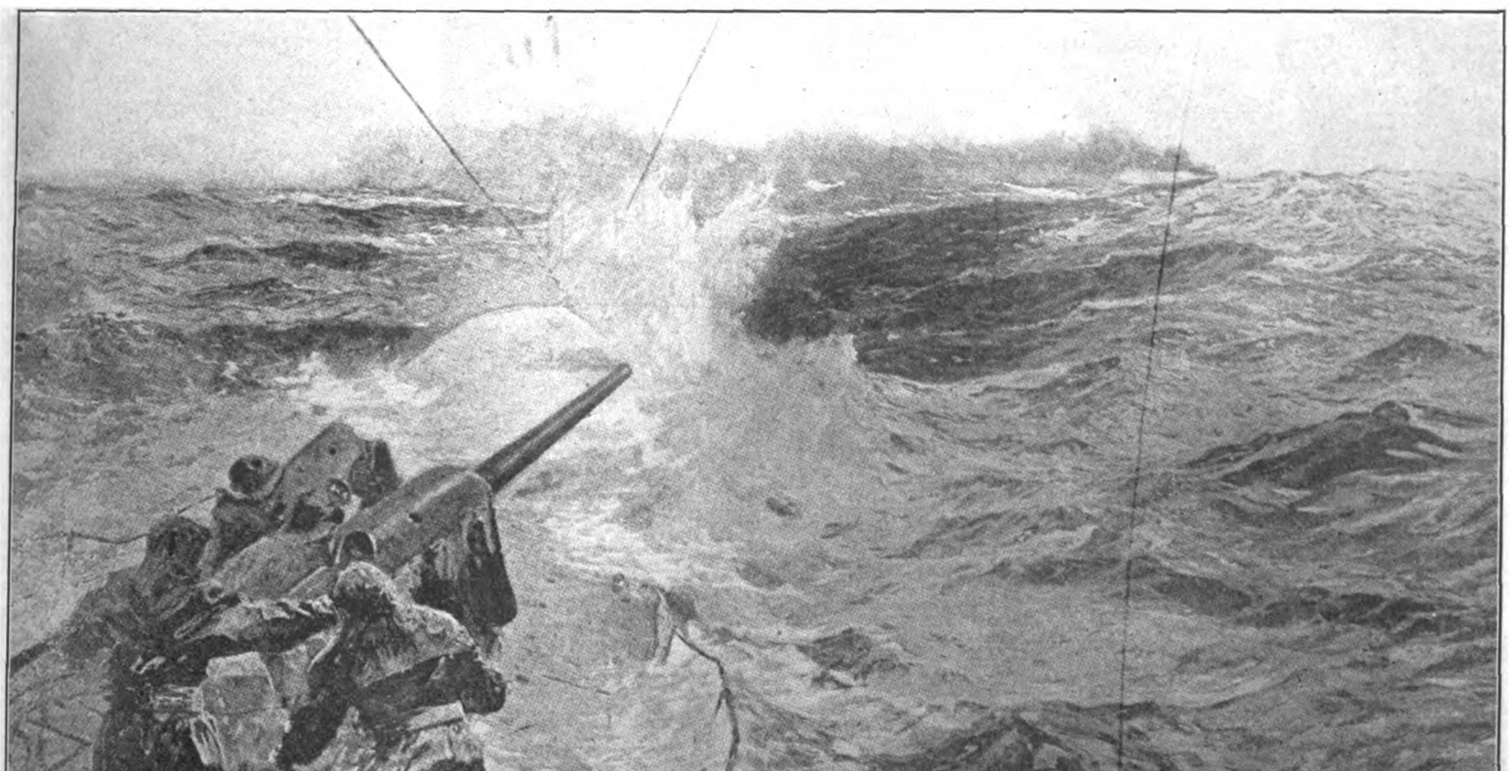
—*Copyright, Underwood & Underwood.*

A MODERN GERMAN SUBMARINE ARMED WITH TWO 5" OR 6" GUNS, WHICH HAS ARMORED DECKS

A U-boat of this type (apparently 1,200 tons displacement) is a formidable opponent to a big T. B. Destroyer, and the first was sunk May 11 last by a large British "Atlantic-escort submarine." Note how cleverly the commander keeps between the sun and the ship she has held up.

We are of the continued conviction that every one of the 80 ft. and 110 ft. boats that have been built are urgently needed, and that they are highly desirable, also that they have been giving splendid and reliable service in the duties for which they have been used. Furthermore, hundreds more should be built as soon as convenient. Without doubt they must have proved very valuable at times against the smaller-type submarines that have been operating within a couple of hundred miles of the British, Italian, and French coasts, especially the new 110 ft. patrols, which it is said are equipped with all the latest detecting devices. Supported by the T. B. destroyers we believe they must have been extremely useful in the North Sea, and off the French shores.

Our remarks regarding "seaworthiness" also seem to have been misunderstood by builders of the smaller craft and by, at least, one contemporary journal. Everyone who has been to sea in small boats knows that if they are well-designed and well-built they can stand storms as well as or better than the largest liner. That we never would dispute! All records show that the 80-footers and the 110 footers are splendid seaboats, and their designers should be congratulated on their success. But, "riding a storm" is another

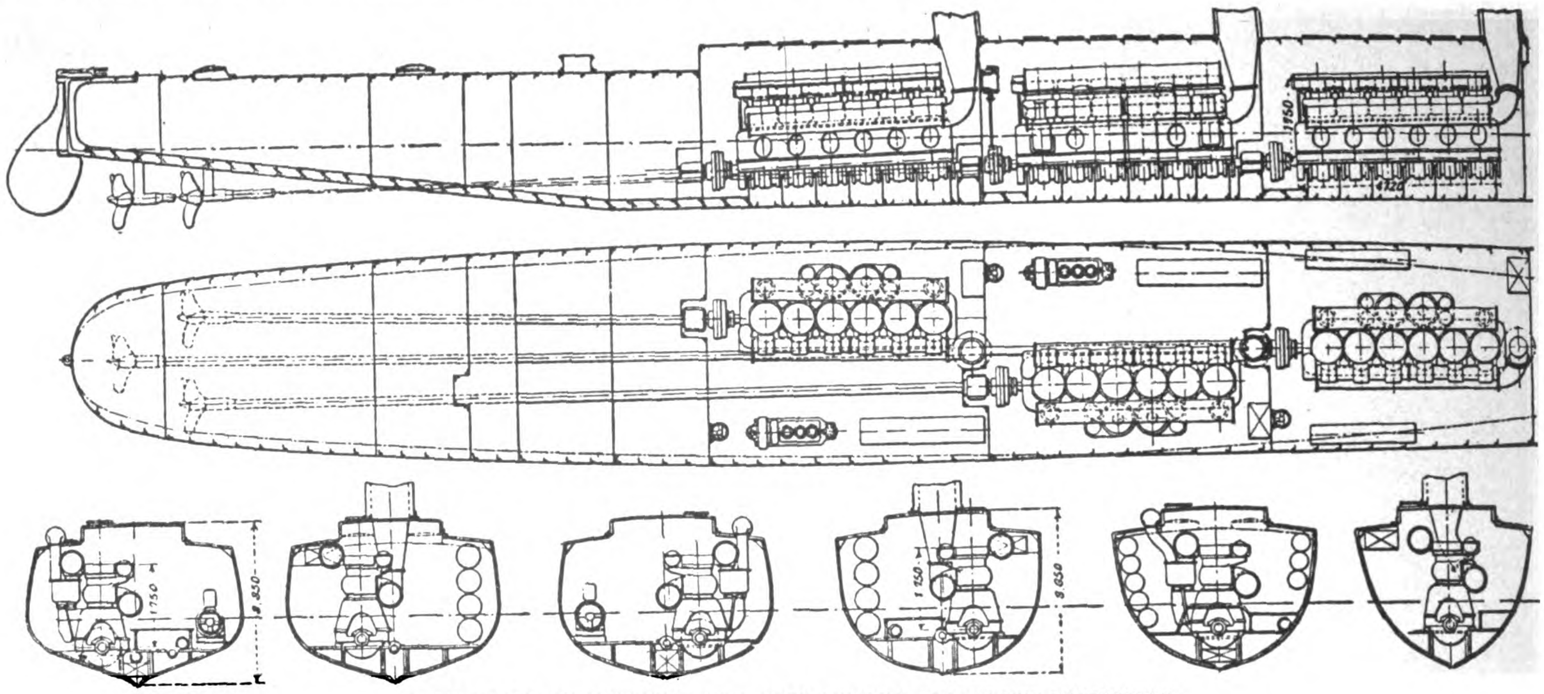


IMPRESSIONS OF A GERMAN NAVAL ARTIST OF A U-BOAT AT WORK —*Courtesy of the "Graphic," London.*

Note how this picture illustrates and indorses our remarks regarding the excellent "detector" formed by the smoke of coal-burning merchant and naval ships. Had the vessel depicted above been a smokeless, funnelless, and mastless Diesel-driven motorship, hardly would have been able to have seen her, and she would probably have gone by undetected. It also vividly illustrates the conditions under which the patrol-boats have to operate.

matter to "fighting a submarine in very heavy weather"! We must not lose sight of the fact that the German submarines operate regardless of climatic conditions and manage to sink freighters and tankers in the heaviest of winter weathers, and occasionally will fight a destroyer: so, a "submarine-chaser" that cannot fight a U-boat in both calm and stormy weather hardly is the ideal vessel exclusively to build for that particular work.

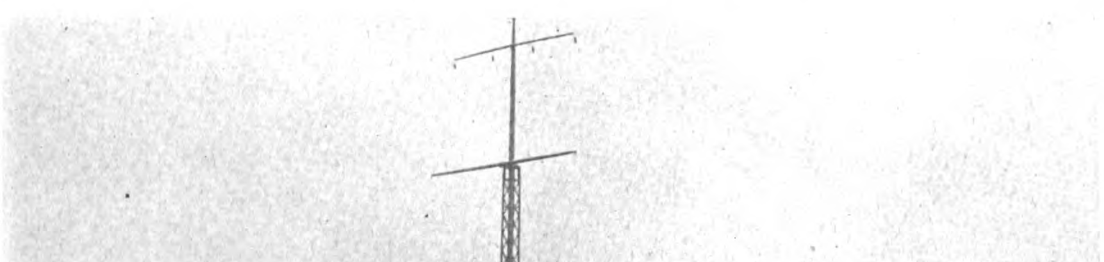
What also is needed are craft that can do nearly equal work to a T. B. destroyer, and that is, proceed several hundred miles and more out into the ocean, and stay there from one to two weeks or longer, and unaided attack a submarine personally told by an important official of the Navy Department that even patrol-craft of 500-tons displacement were too small for submarine work in the Atlantic. At the time, however, we could hardly bring ourselves to the same conclusions, and later on the same official was closely connected with the initial building of the 200-footers at the Ford plant, which craft are about this tonnage. As far as "keeping the seas" is concerned we shall not be surprised if the 110-footers were better than the 200-footers, as the latter are of a finer-lined and faster type. cidentally, were the 200-footers motor-driven, instead of steam-propelled, we believe they would power-plants. These vessels are reported to have been found of great value, therefore others should be built, and there is no reason why five to ten thousand could not be built. But it is the opinion of this journal, based upon careful observation and authoritative information covering a considerable period of the war, that the actual work of destroying enemy submarines would greatly be expedited by the creation of a new and additional class of oil-engined destroyers of not less than 175-200 ft. Originally we proposed 135' to 200' boats; but, 135' perhaps now is too near the 110-footers, of which there were none at that time. The production of such a class of boats certainly



ENGINE-ROOM ARRANGEMENT OF A DIESEL-DRIVEN "SUBMARINE-DESTROYER"

on the surface should she be fortunate enough to meet one willing to put up a fight without submerging, as well as attack with depth bombs if the U-boat decides that discretion is better than valor. By this we mean a boat that can consistently accomplish the same as a type, not merely as a special or occasional feat. This is no sense a decrying of the American-built M. L.'s of the British Navy, which according to reports, frequently have put up some remarkably seaworthy performances in heavy weather. We are of the opinion that in the near future German submarines, if they can get through the North Sea, will operate in mid-Atlantic where the smaller patrol-craft cannot be used so efficiently as larger vessels, especially those equipped with economical heavy-oil-engines. At this critical period no chances must be taken—and the U. S. Navy Department have shown recently that they intend taking no chances. Hence the 200-footers now on order at the Ford plant!

Not long ago when at Washington we were



"S. P. 54," A DUESENBERG-ENGINED PATROL-BOAT

have even a much better all-round efficiency than they will possess.

It may be remembered that Sub-Lieut. D. V. Hotchkiss, an experienced naval-architect who has been in command of one of the 80-footers patroling in the North Sea since first they were placed in service, advised our readers that if there should be an error in fixing the size of patrol-boats it should be on the large side.

In the North Sea an addition to the present fleet of gasoline-engined patrol craft of well-armed Diesel-driven 200-footers should be of particular advantage—at least, that is the conclusion we have formed, and sometimes the "armchair critic" can formulate correct theories, provided he can take a practical view of the situation?

But, let us say once and for all that "Motorship" does not advocate the elimination or a curtailment in the production of the 80 and 110-footers. Indeed it would be a great mistake not to utilize to the fullest degree the present facilities for building vessels of this size, and their would not interfere with the production of the 80 ft. and 100 ft. boats, and should not interfere with the production of large steam-driven torpedo-boat-destroyers, as there are other facilities which can be utilized for the purpose, consequently the proposed class would create an additional means of eliminating the U-boat menace.

To familiarize ourselves with the difficulties that confront the Allied Navies let us turn our minds to the war zone. Let us suppose a number of 80 ft. or 110 ft. patrol-boats form a reasonably effective barrier across the North Sea, and that they are "listening" and watching for outward-bound submarines. They don't know when the submarine will be along or where she will pass; but, by means of air-scouts or by listening herself, the submarine will know exactly where the "patrols," or "scouts," are, also where the supporting destroyers are situated.

Eventually the U-boat nears the first cordon, and probably will endeavor to pass through the center of the gap between two patrol-boats. They no doubt will hear her, and endeavor to get her exact location, at the same time sending a wireless to the supporting destroyers. Meanwhile the submarine below the water knowing of the presence of the "scouts" also stops to "listen" every once in a while. If they get near her and make it too hot for the U-boat's liking, up she will come and possibly show fight as a desperate resource, rather than stop down to be depth-bombed. If the destroyers are not near enough to interfere she probably would sink the small patrols by superior (i. e. heavier) gunfire unless some of them were large patrol vessels, such as the Diesel-driven 200-footers proposed by "Motorship." Should, however, the destroyers come within range of accurate shooting, the U-boat will quickly seek safety in submerging again, knowing that whilst the destroyers are nearby the patrols cannot "listen" for her, and that the destroyer hardly will risk being torpedoed by shutting down power in order that the patrols may "listen" and exactly locate the submarine.

Without the submarine being almost exactly located the chances of successfully depth-bombing her would be very small, because of the expanse of water. Now if the patrols that did the "listening" were a combination of the present 80-footers, 110-footers, and large, and well-armed, 200-ft. boats they could fight and probably destroy the U-boat if she came to the surface upon being located, and there would be no necessity for supporting T. B. destroyers to dash up and spoil the tempers of the locating-operators aboard the patrols.

No doubt those who have read the official testimony before the Naval Committee of Congress of Secretary-of-the-Navy Daniels, which was published verbatim in our March issue, will agree that the various opinions expressed in these columns from time to time regarding the size and speed of suitable craft for submarine patroling, have been exceptionally accurate and useful.

If our conclusions are incorrect then Secretary Daniels could not have accurately described the situation regarding submarine-chasers. Similar opinions to our own since have been expressed by British marine contemporaries, and they even are in a better position than we to obtain first-hand knowledge!

No article on the work of motor-craft in this great war would be complete without some reference to hundreds of 80-footers built by the Elco Company, including (censored) for the British Government in less than a year from the date of order. It was a most remarkable achievement and the greatest of its kind ever attempted. Constructing the engines was an equally remarkable feat, as it meant (censored) reversible gasoline motors of 220 b. h. p. each. This was accomplished by the Standard Motor Construction Co., who also built similar motors for the (censored) U. S. Navy 110-footers, each of the latter vessels having three engines of the same power installed. Altogether they have built about (censored) of these 220 b. h. p. gasoline engines since the war—or rather since 1915. Nearly half-a-million horsepower in that time really is a stupendous task. Yet it was successfully accomplished, and these engines we learn have given splendid service on the whole, and have been a fine testimony to the builders.

For the (censored) eighty-footers there can be no doubt but that gasoline-engines were the best under the circumstances. Not only would it have been a harder task to have built crude-oil engines in the short time, and not only would have their heavier weight detracted the speed of these boats; but, it would have been a tremendous job to have specially trained four or five thousand British engineers as operators, whereas thousands of men with more or less a knowledge of gasoline motors were available in Great Britain when these vessels were ordered, which made the work of instructing them much easier.

"S. P. 86," A FAST PATROL-BOAT DONATED TO THE NAVY BY CAPT. J. J. PHELPS.

the shores of the United States these craft may be called upon to assist in the "swatting" work or searching for submarine supply bases. However, as the present work of these coastwise patrol-boats was fairly fully outlined in "Motorship" of April, 1917, there hardly is need to repeat their duties here, so let us devote the space to details of some of the boats engaged in that particular service.

Since America's entry into the war, there have been many displays of individual patriotism on the part of yachtsmen throughout the country; but, there has been no collective movement which can surpass that of the members of the Eastern Yacht Club of Marblehead, who have turned over eight 62-foot patrol-boats to the Government. There were 14 members of the Yacht Club who banded together in groups and financed the building of these vessels, the original names of which and the owners are as follows:

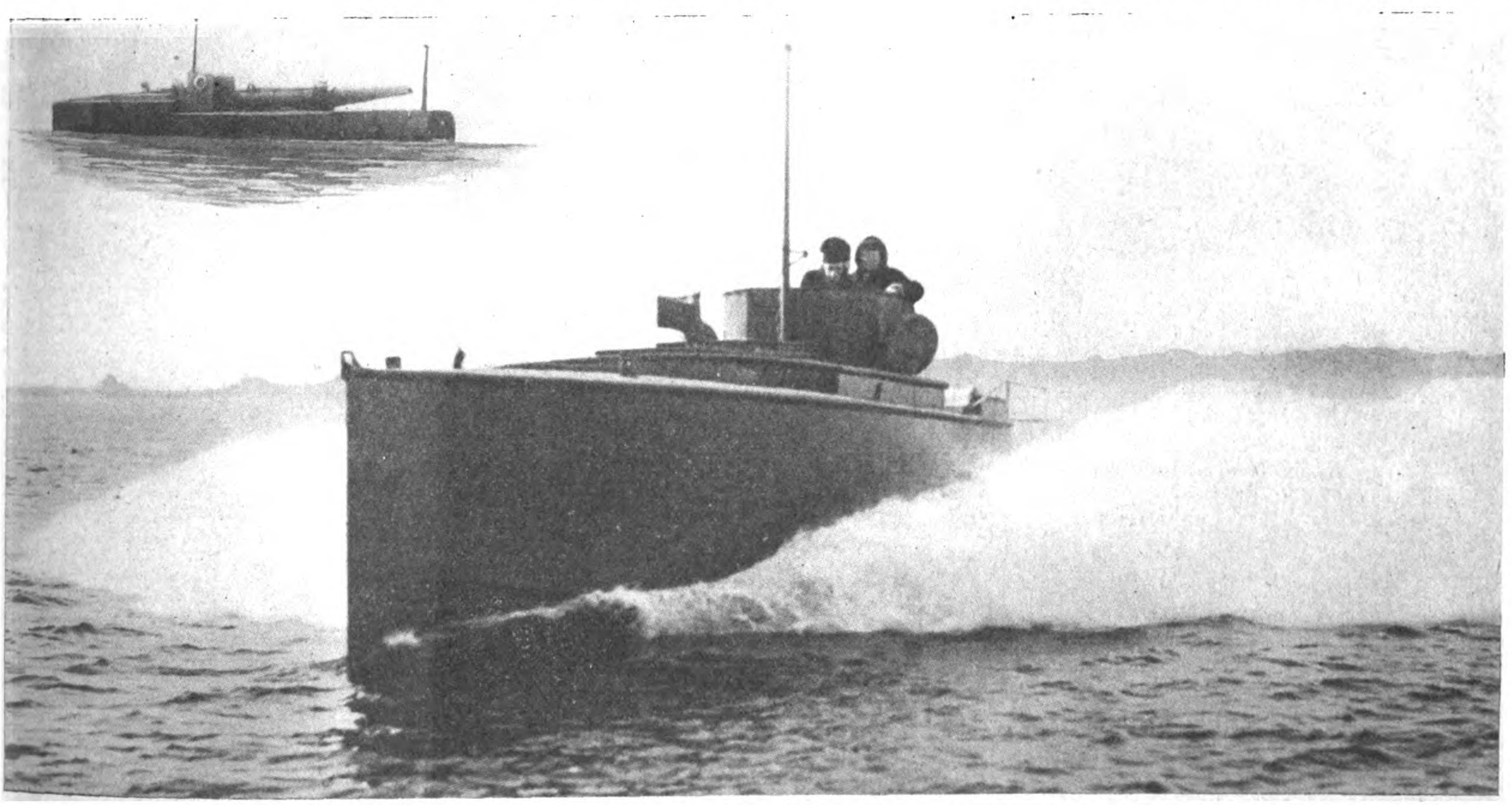
"Daiquiri"—Charles F. Ayer, Osborne Howes, Frank S. Eaton, Oliver Ames.

"Ellen"—Charles P. Curtis.

"Sea Hawk"—Arthur Winslow, Edwin S. Webster, Charles A. Stone.

The united efforts of A. L. Swasey (who designed the 110-footers) and N. G. Herreshoff are responsible for the design of these craft. They are 62'x11'x3'6" and were built by the Herreshoff Mfg. Co. of Bristol, Conn. The power plant consists of two 8-cylinder 200 h. p. Sterling gasoline engines 400 h. p. in each of the boats, which were planned for a speed of 24½ statute m. p. h. The contract speed we are told was exceeded by several miles and that these boats are actually capable of 27 m. p. h. in case of emergency.

Just previous to America's entry into the war a small motor-driven "torpedo-boat" was built for the U. S. Navy Department by the Greenport Basin & Constructing Co. She was quite a little craft of which speed seemed to be the main object in view and she attained over 40 miles an hour on official trials. She is 50 ft. long and was designed to carry a machine-gun forward and an 18-in. torpedo tube aft. We give an illustration of her and she is 50' long by 11' beam, and 4'



A 50-FOOTER BUILT FOR THE NAVY DEPARTMENT PREVIOUS TO AMERICA'S ENTRY INTO THE WAR

She was designed to carry a machine gun forward and a torpedo aft. On her official trial a speed of 40 m. p. h. was attained.

Some remarks are necessary about the hundreds of privately-built patrol-craft, and converted yachts, that have been placed at the disposal of the Navy Department by patriotic yachtsmen, and which in many instances are giving valuable and splendid services patrolling Uncle Sam's coasts, harbors, and waterways. Whilst it may not sound so heroic as "swatting submarines" the work in its own way is equally important, as it has got to be done. Should the U-boat campaign extend to

"Apache"—Robert F. Herrick, Harvard Rowing Coach.

"Inoa"—Frank C. McQuesten.

"Kangaroo"—Henry A. Morse, Charles A. Morse, Everett Morss.

"Commodore"—Property of the Flag Officers of the Eastern Yacht Club, viz. Commodore, Herbert M. Sears; Vice-Commodore, Max Agassiz; Rear Commodore, J. S. Lawrence.

"Snark"—Carll Tucker, of New York City.

draught, and is driven by a pair of eight-cylinder 400 h. p. Duesenberg gasoline engines that turn two Columbian 24"x36.7" propellers.

A number of patrol-craft of somewhat similar design were built by the same concern and also equipped with Duesenberg and Van Blerck gasoline motors. One of these is "SP. 86" ex "Perfecto," a 60' by 9½'x2' 10" boat turned over to the Navy Department by Capt. J. J. Phelps of Hackensack, N. J. A duplicate, but of a little less power,

THE PATROL-BOAT "S. P. 790," DRIVEN BY TWO 200 H. P. STERLING ENGINES

was built for Mr. J. H. Belletine of N. Y. C. Both the latter craft were Duesenberg-engined, and a speed of 30.05 knots and 25.9 knots were obtained on trials respectively.

Furthermore a large number of patrol-boats of similar design and construction have been purchased by the Russian Government, and we give an illustration of a 72-footer that was built for the Russian Admiralty, and equipped with Duesenberg motors. Another craft, "No. 63," also owned by Russia, together with many sister vessels, is 60′ long by 9½′ beam with 3′ draught, and is driven by a pair of eight-cylinder Duesenberg gasoline-engines that turn 24′ x 26.7″ Columbian Ailsa-Craig propellers at 1,225 r. p. m., giving a speed of 29.8 knots on trials. Upon declaration of war, the U. S. Navy Department took over two of them.

"S. P. 54," ex "Bonita," which we also illustrate, is an attractive looking example of coastal patrol-craft, and was built by Mr. Hermann Oelrichs of New York, and handed over to the U. S. Navy. She was designed by Swasey and built by Lawley, and is driven by two eight-cylinder Duesenberg gasoline motors that turn two 28″ by 28″ Columbian architect propellers at 1,300 r. p. m., producing a speed of 27 knots.

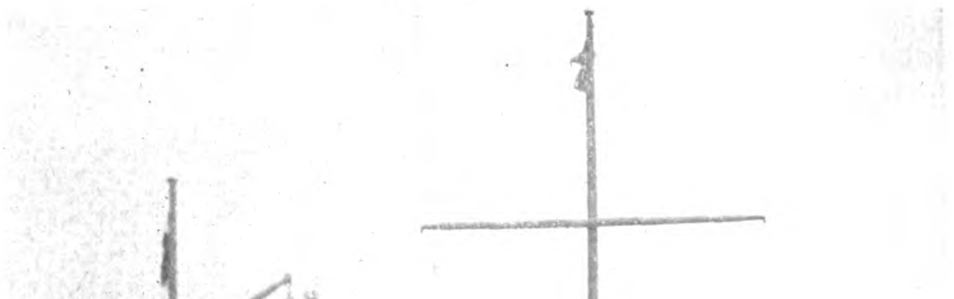
Inbound steamers entering the waters of the Second Naval District are being halted and conducted through the channels in the mine fields and nets by two patrol-boats, namely "S. P. 908" and "S. P. 909," manned by officers of the Naval Reserve.

The two craft above referred to were built for Mr. Warren Ackerman and Mr. Reginald Rowland of Plainfield, N. J., who own the "S. P. 908" and Mr. Stanley Mortimer and Mr. L. Anson of New York, owners of "S. P. 909," and handed to the Government. They are 60′ in length, 10′ beam and 3′ draft, and were designed by Tams, Lenare & Crane. They are of the round-bilge type and have a speed of 19½ m. p. h. Both craft are powered with 6-cylinder Sterlings, and turn 24″x25″ Columbian Ailsa Craig propellers at 1100 r. p. m. The total horsepower per boat is 250. Considering the weight and draft of the hulls, which carry an armored conning-tower, the speed is beyond criticism, as it is sufficient to quickly overhaul any steamer requiring attention. These boats are double-planked with Port Orford cedar and are arranged so as to sleep ten people.

And finally we will refer to the "S. P. 790" ex "Enterprise" which was constructed for Mrs. W. Plunkeet Stewart of Philadelphia who was the first woman of the country to have gained the distinction of having a boat built for Naval patrol-work. The construction of this craft is extra heavy so that guns could be placed on the deck. She carries a three-pounder aft and a one-pounder forward. The length is 65′ 10″, the beam 12′ and the extreme draft 3′ 6″. The design is by Bowes & Mower of Philadelphia, and the boat was built in the yard of the Frederick S. Nock Shipbuilding Co., of East Greenwich, Rhode Island.

She is somewhat similar in appearance to a small torpedo-boat-destroyer, due to her high raised-deck forward and the low raking funnel. The two 8-cylinder, Sterling gasoline engines located amidships are said to drive her at 24 to 25 m. p. h. cruising speed. The gasoline tanks have a total capacity of 400 gallons, or a cruising radius of about 250 miles at full speed. It is figured that the fuel consumption is in the neighborhood of 40 gallons per hour. She was delivered to the Navy on October 12th, 1917.

A typical instance of the great value of motor-craft in naval work was demonstrated by the splendid service rendered by the American-built patrol boats during the recent raids made on the Ostend and Zeebrugge submarine-bases by the British Navy. Two of them are said to have rescued nearly 200 members of the crews of the concrete-filled "block-ships" sunk at the entrance to the Bruges Canal. Splendid work too, was accomplished by the British explosive-laden submarines, the crews of which also were rescued by one of these motor patrol-craft.



"MYSTERY II," A 71-FOOT PATROL-BOAT BUILT FOR RALPH PULITZER OF NEW YORK CITY, AND NOW IN THE NAVAL RESERVE FLEET OF COASTAL CRAFT

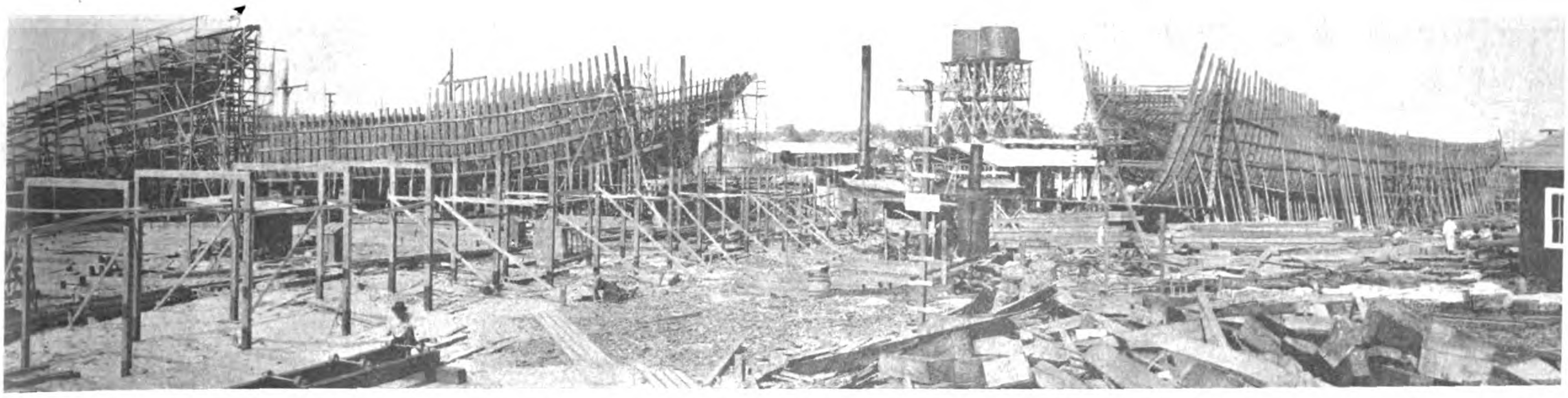
RECORD LONG-DISTANCE RUN BY SUBMARINES.

The longest-distance run ever made by Diesel-driven submarines under their own power was in 1914, when the AE-1 and the AE-2 cruised from Portsmouth, England, to Sydney, N. S. W., Australia. Each of these boats was powered with two 850 b. h. p. Vickers-Diesel four-cycle type crude oil engines.

AN ACCURATE FORECAST.

A year ago the British authorities announced that the submarine menace was over; but, in an editorial-leader in May, 1917, issue of "Motorship," we said that,—"we can be certain that Germany will sink at least 500 additional merchant vessels, or 2,000,000 tons, if not more, before she is defeated." As in the case of many other forecasts made by this journal this statement proved very accurate. In this instance we were on the moderate side in our estimate. But, we are not unmindful that all other papers at that time were cheerfully discussing the defeat of the U-boats, due to the sinkings suddenly having dropped from 60 ships to about 15 ships per week. The menace is still before us and we must build ships, ships, and ships, faster than ever, and they must be motorships.

BUILDING AT THE ORANGE SHIPYARD OF THE INTERNATIONAL SHIPBUILDING COMPANY



with two 200 b. h. p. Fairbanks-Morse surface-ignition type heavy-oil engines. Dimensions of ship; Length 301′, breadth 46′, depth of hold 22′ 8″

tor, these financial facts are to be laid beside the fact of the lack of demand for these oil engines. Nevertheless, as time goes on, inventors, designers and research men are not deterred from trying out schemes, so that, in spite of this lack of financial and business encouragement, there is, notwithstanding, a very considerable degree of progress—much slower than it ought to be, but nevertheless real. Unfortunately, in this case the public in general is not informed about this progress and, therefore, when due to a change in economic conditions, the time comes to make use of all the available information on the subject, we suddenly wake up to the fact that it is in the hands of a few people and the rest of the public knows nothing about it.

I have said that the present is a time of change, and I think there are two reasons for that. In the first place, the war has brought about a shipping situation which is unprecedented in the history of the world. There is a demand for ships today such as never existed before, but there is at the same time just as real and as strong a demand for the men to run those ships. The heavy oil engine is one of the various possible ways of driving a ship, providing the ship be not too large. Its fuel economy is a direct value in ship operation, since it gives a larger cruising radius or the maximum possible cargo capacity. It, furthermore, is peculiarly adapted to a ship, in view of the fact that we are facing a labor shortage in ship operation, and the heavy oil engine ship can be operated with less men below the deck than any other type of vessel ever produced—except, of course, the small gasoline boat. The war, then has brought to our attention this heavy oil engine as a possible motive power for the smaller of these new merchant vessels as well as naval vessels, though more merchant than naval. And it is a fact that shipping people are considering this question today all over the country, but most of them are afraid to act. They would all like to, as near as I can find out by talking to them, but they are afraid to act. To my mind the time is not far distant when they will have to act, or lose something by not acting.

Aside from the shipping situation, there is another reason, and that is the economic reason of an appreciation of the value of this wonderful fuel that nature has placed beneath our country's land surface. This fuel is peculiarly adapted to this sort of use: the generation of power in internal combustion engines directly, with the highest possible efficiency and the least possible man attendance. Now, that fuel has been wasted in this country, especially in that region of the country near the oil fields, just because it was plentiful. Nevertheless, we are coming to the point when the people of the country—if not the people certainly the government—will be compelled to force the abandonment of the use of this fuel for all purposes where other kinds of fuel that can be had in more plentiful supplies would do as well. When you consider that oil or petroleum is the only kind of fuel that can be used in the high efficiency engine, then it becomes clear that to burn it to warm a living room where charcoal or wood or coal of any grade would do quite as well is to commit a sort of economic crime. That feeling and the financial consequence of not acting upon the realization of that situation will, I believe, come to a climax before very long, and result in a plan for conservation of our liquid fuel or petroleum supply, so that it shall be used for only such purposes where it is peculiarly adapted and be barred from all other uses where other things will suffice. In the natural course of events people wait for prices to bring such a situation about, but, gentlemen, this is not a time that properly is classifiable as belonging in the natural course of events. This is a time which is distinctly abnormal and unnatural. We hear every day plans proposed and turned down because there is no precedent, with always the rejoinder that here we are in a great war for which there is no precedent, so why follow precedents in other things? We have been forced to change in a thousand and one things, so let us change in a thousand and two things and do it quickly.

I could expand to considerable length along the lines of the economic situation with regard to the use of oil and the peculiar adaptability of oil in the internal combustion engine, and the particular adaptability of that class of engine to the ship service, but I want you to realize that there is another field also where there is a demand slowly but surely growing up, and that all these separate demands coupled with the growing change in the economic situation must certainly, one piling on top of the other, produce a new condition which I think, I foresee. We have a real gasoline automobile industry; it is becoming a great manufacturing industry, but it is today tied up to and inherently dependent upon the lighter petroleum distillates. We have no highly economical gasoline or kerosene engine, and there is every reason to believe fundamentally that none can be produced on the present system. To make our automobiles and motor trucks and tractors run, and to make our available sources of fuel supply last, there seems to be only one solution, and the leading engineers and mechanics in the automobile industry are beginning to talk about that solution, the adaptation of the heavy oil type of engine to the high speed class of service, such as the automobile and the tractor require. It is coming; there can be no question about it. If anybody is able today to produce the high speed type of engine necessary, even though it costs more money to build, you may rest assured that it will be adopted very quickly. There is a third field, and that is the field of direct-connected electric generating sets. For a long time in the gas engine business we built engines to drive generators in a kind of haphazard fashion. As time went on a particular type of outfit began to appear—a direct connected high speed generating set, with engine and generator on one base, self-contained, the best examples of which on a small scale is the Delco lighting outfit, which is being sold at the rate of over 50,000 sets a year now, all over the country districts. There are corresponding units of other designs in larger sizes. The fact that these sets are generally confined to gasoline, limits their use because in many places gasoline is unsafe to use; in other places it is not obtainable; in still others the cost of it is prohibitive. It is apparent that if we had the heavy oil engine adapted to that class of high speed multicylinder service and with the necessary degree of regulation, it would open still another field.

So, in the field of application of the heavy oil engine, I see just ready to be invaded—these three things; first, a widened use for ships; second, a new use in the automobile type of motor; third, a corresponding new use for direct-connected high speed electric generating sets. Whether they be used on land or aboard ship, it does not matter. If they are designed right they are serviceable in either place.

With this sort of introduction, I think it is of interest and particularly pertinent at this time to review some of the ideas that have been developed to date, and some of the suggestions that are available as lines of possible development in the direction of real progress. And this review I divide, for the purpose of clarification, into two topics,—functional and structural.

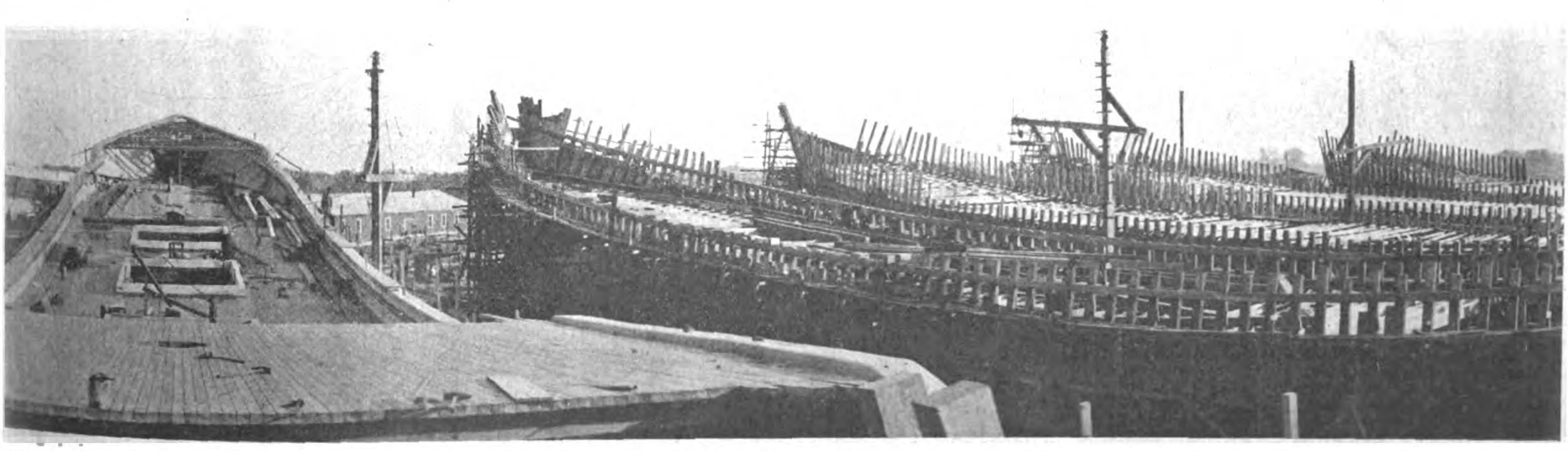
Under the functional, come all those questions connected with the supply of air, the supply of oil, the establishment of the proper relations between the oil and air to give the desired control of combustion after the necessary compression—in fact all those physical processes involved directly in the development of the power within the cylinder.

Under the head of structural would come all those principles of type arrangements or typical part forms, and proper proportions of the metal structure that houses these physical processes and thereby produce a machine.

The first item under the functional discussion is that of charging the cylinder with air, and this is carried out by either the so-called and well understood 4-cycle system of two valves per cylinder, or by any one of several 2-cycle schemes. On the 2-cycle schemes there are, as I have indicated, a number. First we have the ordinary crank case precompression chamber, which is barred from any engine of more than diminutive size, because the closing of the crank case prevents access to the working parts, in addition to imposing other bad conditions. The first step in avoiding the difficulties of the closed crank case which I say are prohibitive in any real engine, comes when the connecting rod and crank shaft are left open and the front end of the cylinder closed, the front end acting as a pre-compression or air charging chamber in conjunction with an air reservoir, which is necessary, so that the pressure in the front end of the cylinder cannot rise too high.

This front end compression arrangement has certain faults that have led to the design and more wide use of others. For example, it is not possible in the oil engine of the 2-cycle sort, with the front end pre-compression chamber to put into the motor end a volume of air equal to the piston displacement; the volume must necessarily be less than the piston displacement measured at atmospheric pressure. That being the case, some of the burned gases or products of combustion cannot be expelled, and, at the same time, the residue is hotter than it otherwise would be. To correct that, the alternative schemes of a step piston, or a separate scavenging pump have been developed, more particularly the latter. The step piston is the first of the scavenging schemes and is a scavenging scheme because the volume swept through by the step of the piston may be made larger than the volume swept through by the motor piston proper, and the excess of this displacement is the scavenging displacement. By means of it more air can be put into the motor cylinder or charge than can possibly stay there at atmospheric pressure. This being the case, the burned gases may be more completely expelled and what is to my mind much more important the residue of the gases left there would be much cooler before the next compression starts.

This step piston has certain faults of a structural nature which need not be detailed, but which are responsible for the more wide use of the alternative scavenging scheme of a separate low pressure compressor, built somewhat along the lines of the old fashioned blowing engine. This arrangement is usually double acting so that one such scavenging pump will



ENGINED MOTORSHIPS BUILDING AT ORANGE, TEXAS

serve two single acting 2-cycle motor cylinders. With it, the 2-cycle engine can then be made to perform all the things that the 4-cycle engine can do, except as to the negative work involved in the pre-compression of the surplus air; so that while the two engines may perform, somewhat the same, the 2-cycle form will be necessarily less efficient by the lost or negative work, and, at the same time, some of the so-called simplicity of the 2-cycle engine has disappeared. So completely has it disappeared that you will find, if you investigate it, that the weight per horsepower has grown in the 2-cycle to be substantially the same as the weight per horsepower in the 4-cycle. That is to say, when you start with the simple 2-cycle idea with the hope of getting half the weight per horsepower, because of twice the number of impulses from the same amount of metal, then you find you have to add this and that and the other thing, and by the time you have gotten through adding enough to make it a real working engine, the weights of both types are just about the same. Therefore, the 2-cycle as compared with the 4-cycle, as to weights, might be called substantially equal. But there is an inequality in another direction. The 2-cycle, acting with more impulses per minute in the same volume, will run hotter and load the same sized bearings to a higher average bearing pressure, and, as a consequence, size for size, the 2-cycle will give more trouble with burnt pistons and overheated bearings than the corresponding 4-cycle. These are just a few of the reasons why this much-mooted question of 2-cycle versus 4-cycle as a means of air charging remains a controversial matter rather than one of settled engineering practice. My own personal opinion about the matter is this: that in the smaller size, let us say up to 100 or 200 h. p. maximum, the simpler form of 2-cycle, not with the separate scavenging pump is a rather good thing and practical. In the next range of sizes, from let us say 500 h. p., the 4-cycle works out best in the long run, and from that point up the pendulum swings the other way toward 2-cycle with scavenging pumps, as matters stand today. But, remember, that in the larger sizes the art is most undeveloped and most of the uncertainty as to what is the proper engineering practice concentrates right there.

The next item under the functional discussion is the introduction of the oil to form either an explosive mixture for explosive combustion, or to prevent the forming of an explosive mixture so that the oil may burn non-explosively. Before examining the means of introducing and controlling combustion of the oil, I want to point out the fundamental and controlling value of air compression before injection on the one hand, and of the rate of oil burning, following the right amount of compression, on the other. Consider the former point first. It can be demonstrated, and it is pretty generally understood now without demonstration, that other things being equal, the more the air charge is compressed before the introduction of the oil, the higher the mean effective pressure will be; and that, of course, is a prime factor in power, and, at the same time, the higher the efficiency, or smaller the fuel consumption. It may, therefore, be said with practically no reservation that in an oil engine as much compression should be carried as is possible. But that is not all. After the compression has been completed, the oil must be introduced either at that time or just previously, so as to produce a suitable and proper combustion line of one of the two characteristic types, or mixed.

The two characteristic types of combustion lines are, first, the vertical combustion line produced by an explosive mixture; and second, the horizontal combustion line produced by a gradual introduction of the oil, the oil burning as it comes in, and which latter system has been called the Diesel system. It is clear, of course, that we might burn part of the oil explosively, raising the pressure a fraction of the maximum, and burn the rest non-explosively without further change of pressure, or we might have such a slow introduction of oil as to cause the combustion line to drop as the piston moves out on the working stroke. The two types of combustion line are (a) the vertical explosive; and (b) the horizontal non-explosive, or Diesel forms. Now of these two methods of oil combustion as to rate which should one choose? That question should be settled before considering the means of introducing the oil, because one is not warranted in spending time in determining how to introduce the oil until there is first a decision as to what end is to be accomplished by it. In other words, we must establish the specifications before undertaking construction.

It will be found by comparing the full diagrams for those two combustion lines with the same amount of oil and expansion of course following both, that about the same mean effective pressure is possible with both or with either. That is to say, so far as power is concerned, there is no choice. But, on the other hand, when you compare efficiency or fuel consumption, then this startling fact comes out—that the constant pressure or Diesel kind of non-explosive combustion is capable of only half the efficiency of the other kind of combustion, the explosive sort. To put it a little differently, and more precisely, if the fuel be burned explosively after compression, then an efficiency can be produced with a corresponding fuel consumption equal to that obtainable with a corresponding fuel consumption equal to that obtainable with non-explosive Diesel combustion when the latter has twice the compression of the former. Again, to put it in still another form: A Diesel diagram with nearly 500 lbs. compression produces no better efficiency or fuel consumption than an Otto cycle diagram with 250 lbs. compression. There is, therefore, absolutely no doubt on fundamental grounds as to which of these two possible modes of burning offers the best promise of results. They are equal in power possibilities and nearly two to one in efficiency with reference to compression. When I say the latter, do not misunderstand me. Do not think that I mean to say or assert that the Otto can give and will always give twice the efficiency of the Diesel—not at all. They can be made exactly equal in efficiencies and fuel consumption with selective compressions, but when the compression is thus selected to do that thing it will require twice the compression with the Diesel as will be required with the Otto arrangement.

This is particularly interesting when you consider that fully 90% of all the development work that has been done with this heavy oil engine has been done with the less promising Diesel cycle, and the very promising Otto cycle has been almost entirely neglected. I say it has been neglected, and yet I do not mean that. It has not been neglected by those people who understood the possibilities—the students of this subject. It has not attained the popularity or the standing in a commercial way that the Diesel has, and thereby hangs a tale which will make another story another day.

In this functional study the next important consideration is the compression itself, and the relation between the degree of compression and the mode of combustion, or control of combustion. The oil has to be ignited, and there are various ways of igniting it. It must not, however, be ignited until the right time comes; that is, not until a sufficient degree of compression has been executed—whatever is desired. Therefore, there must be an igniter and the ignition, as a process, must be under control. Now, the ignition will always take place whenever any fuel in contact with air reaches the ignition temperature. The air under compression is rising in temperature and is approaching or passing the ignition temperature in that process of compression. Somewhere or another in the process of compression, if it be carried far enough, ignition temperature will be established and ignition will inevitably occur, if there is any oil in contact with the air.

It is, therefore, essential, in considering the limit of compression in its relation to the introduction of oil to have some kind of mental picture, and preferably exact figures as to the way in which the temperature rises in compression, especially with reference to the ignition temperature as a basis of reference.

The ignition temperature of these heavy oils is a somewhat uncertain physical constant, but from my experience, I am inclined to think this is very close to 950 degrees F.—near enough to that for practical purposes any way, and we will let the physicists fight about the other few degrees.

To bring this matter before you, I have prepared a little table here.

COMPRESSION VS. INITIAL TEMP. VS. IGN. TEMP.

Compression Lbs. per Sq. In. Above Atm. (14.7) With .1 Lb. Valve Drop.

Ign. Temp. of 950° F.		200° F. Below Ign.		200° F. Above Ignition.		400° F. Above Ignition.	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
190	293	104	152	305	511	467	800
100	155	58	79	181	279	282	460
67	92	34	42	114	165	175	275
41	52	18	22	75	101	118	174
23	31	8	10	47	63	79	107

$$\text{Base on } S = \begin{matrix}(1.33)\\(1.40)\end{matrix} \text{ In. } P = 14.6 \left(\frac{T\ \text{Final}}{T\ \text{Initial}}\right)^{\frac{S}{S-1}} - 1$$

This table shows at the left, first column, initial air temperatures of from 200° F. to 1600° F. before compression. Starting with these temperatures, then, to reach ignition temperature it would be necessary to have the compressions, indicated in Cols. 2 and 3. To reach a temperature of 200 degrees less than ignition temperature, the compression would be as shown in columns 3 and 4. To reach a temperature of 200° F. over ignition temperature, compressions required are shown in columns 5 and 6, or for 400° F. over ignition temperature the compressions of columns 7 and 8.

I am going to explain this a little further, because it is most significant. Starting with atmospheric air at a temperature of say 70 degrees F. in an engine room, it is drawn into a cylinder, and it is bound to become somewhat heated on its way. It will become heated by contact with the hot intake ports, sweeping over the intake valves, sweeping against the interior cylinder walls, which are very hot, especially in large engines with thick metal, and finally it mixes inside with the hot products of combustion from the previous shot. So, to say that this 70-degree air will rise 130 degrees and have a temperature, therefore, of 200 degrees when compression starts is a very moderate estimate. I think it is never less than that, and that is the reason I have made this the minimum figure. It might easily be much more than that, especially when you consider that in some of these engines the interior is red hot in spots; and in some of them the whole wall, especially the hot bulb type, is deliberately kept red hot, as an igniter. It is quite clear that any products of combustion or air in contact with that red hot spot might easily approach or exceed a temperature of 600 degrees before any compression is done at all. So I make the temperatures before compression range anywhere from 200 to 600 degrees, and I think there is justification for even going further.

Now, when the compression starts the pressure follows this general law, given at the bottom of the table, and from that certain variations follow: but we are not quite sure as to what value the exponent "S" has, although we do know that it cannot be bigger than 1.4. We know by experience that it is not less than 1.33. So, for each one of these values I have calculated two figures—the compression pressure in pounds per square inch above the atmosphere—and you see here that to reach ignition temperature with 200 degrees initial temperature would require 190 lbs. compression minimum to 293 maximum actually—somewhere between; it is difficult to fix it any closer. Whereas, if the initial temperature was 600 degrees then the ignition temperature would be reached in that same cylinder with a compression of only 23 to 31 lbs. That brings out in the most striking fashion this fact: that if the fuel is in contact with the air in the cylinder during compression, then the amount of compression cannot be very large in any case without producing an uncontrolled pre-ignition. And more important still, if any part of the oil and air is very warm before compression starts, then you can carry practically no compression at all. And, if you cannot carry much compression then you have a very high fuel consumption and a very low efficiency. An engine carrying such low compressions as are here required would burn nearly two pounds of oil per hour per horsepower, whereas the best engines are today running on about four-tenths of a pound—a ratio of five to one.

Now, suppose that we had an igniter that was itself under control, and that we had fuel in contact with the air in the cylinder. Question: How much can we compress it without any danger of pre-igniting it, so that when we want to fire it can be fired with the igniter that is under control? I suggest that 200 degrees margin is about as good as you could guess at. Let us limit the final compression temperature to something like 200 degrees under the ignition temperature, in which case these are the allowable compressions: with 600 degrees initial temperature, the final compression pressure is 8 to 10 lbs. With 200 degrees initial temperature, 104 to 152 lbs. (See table).

On the other hand, suppose that the system was such as the Diesel, where the air temperature itself is to serve as the igniter. In that case, to insure ignition, we should have a margin of about 200 degrees in the other direction: that is to say the air should be compressed to a sufficiently high pressure to not only produce ignition temperature but 200 degrees more, to make sure, in which case the last two columns give the compressions that are necessary. Should the oil now be introduced into the cylinder by means of compressed air to make a fine spray and scatter it through the charge of air, in accordance with the general practice, then it must be remembered that this air jet which is doing the spraying and the scattering is itself exerting a cooling action. Consider 1000 or 1200 lbs. air expanding through the spray valve into a cylinder with about 300 or 400 or 500 lbs. compression pressure and you can readily see that there is a very considerable cooling action right at the jet. That is going to act as a preventor of ignition, and to make sure that the oil will ignite in spite of such cooling influence at the point of oil injection, it is necessary to carry the compression still higher. Let us provide at least 400 degrees over ignition temperature, in which case with an initial temperature of 200 degrees we would require something between 467 and 800 lbs. compression. With 600 degrees initial temperature we could secure this 400 degrees above ignition with anywhere between 80 and 100 lbs. compression.

I would suggest that these figures be made the subject of some study and that they be used in considering the various structural arrangements, because in them will be found a key to the questions: Why cannot this type of engine—this arrangement—be efficient? And why is the other arrangement highly efficient? Here also will be found the key to the question of how we should proceed to make the less efficient one more efficient. These three elements stand out:

First, is the fuel in contact with the air during compression, or is it not?

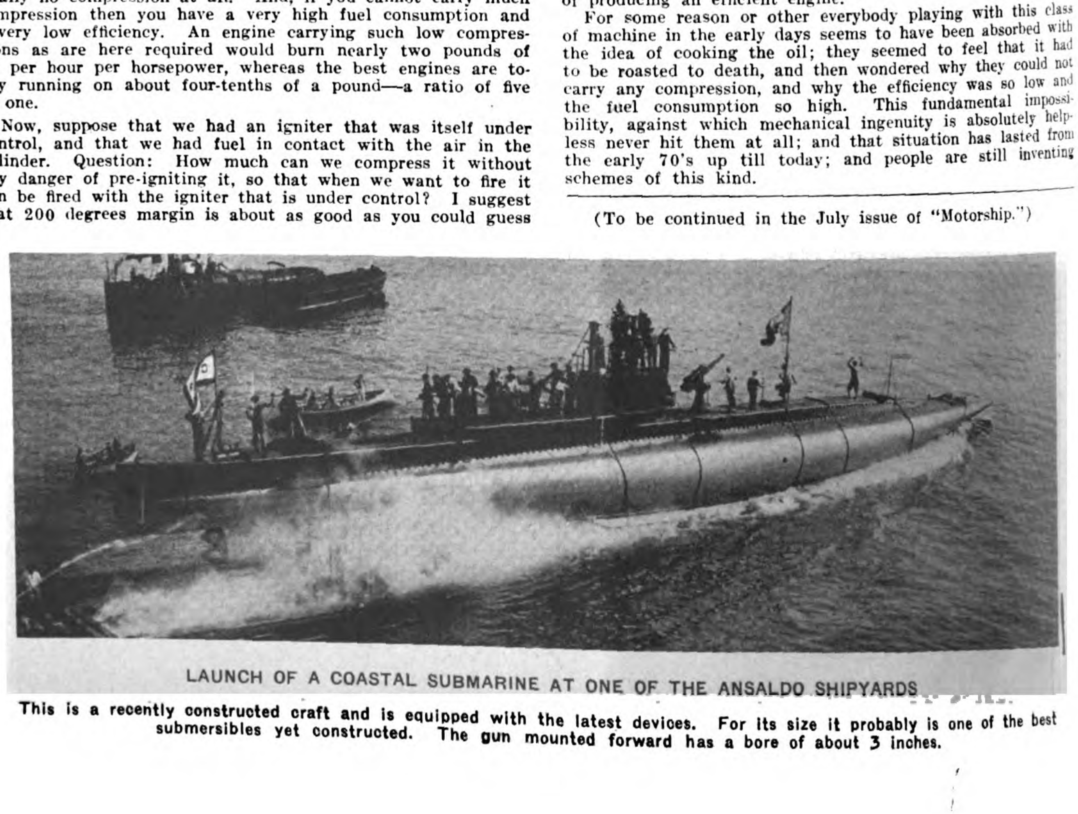
Second, if the oil is in contact with the air during compression, is the region of contact all of low temperature, all of high temperature or any part of it a high temperature region when the compression starts? The initial temperature has a great effect on the degree of compression.

Third, if the oil is not in contact with the air during compression but has to be introduced subsequently, how should it be introduced with reference to the igniter? If the air itself is going to be the igniter then a certain high value of the compression must be obtained, or the engine won't run. If the air itself is not to be the igniter, then what kind of an igniter can be provided? That question we will look into.

All the first oil engines to attain commercial success had vaporizers. That is to say, there was some element, the duty of which was to heat the oil alone for later air mixing, or to heat the oil and air together, to produce a vapor air mixture. It matters very little as to what were the details of those arrangements—whether one produced a heavy carbonizing action and another one did not. They are all one as regards this point of controlling importance: the mixture when formed by any such vaporizing system is necessarily a warm or a hot mixture. Just how hot it has to be depends upon the vapor pressure of the particular oil, or rather the heaviest constituent of that particular oil, and I will give you some figures to make it clear. A 60° Baume gasoline, vaporizing in air, requires a temperature of about 100 degrees to 110 degrees. The ordinary lamp kerosene of 150 flash point vaporizing in air, requires a temperature of 250 degrees. A navy fuel oil vaporizing in air requires a temperature of 420 degrees. And so on. One could go on with any grade of oil or residue for each. There is some temperature at which the vapor of the oil can be produced in the right proportions for combustion and in contact with its air, without residue, and dry. The heavier the oil the lower its vapor pressure or that of its heaviest constituent, then the hotter that mixture must be to be a gaseous mixture; and the hotter it is, according to this table, the lower the compression that it can stand without self-igniting. Therefore, only those fuels that have high vapor pressures or that can make cold gaseous mixtures can be treated with the whole mass under compression. Those oils which are within the class of heavy oils, and which have so low a vapor pressure as to require 300 or 400 degrees initial temperature outside the engine plus a couple of hundred degrees rise in temperature coming into the cylinder can be compressed hardly at all. Therefore, such heavy oil engines cannot by any possible conformity with nature's laws be efficient. You may, therefore, take it as fundamentally sound that all those schemes for heavy oil engines that involve vaporizers are utterly incapable of producing an efficient engine.

For some reason or other everybody playing with this class of machine in the early days seems to have been absorbed with the idea of cooking the oil; they seemed to feel that it had to be roasted to death, and then wondered why they could not carry any compression, and why the efficiency was so low and the fuel consumption so high. This fundamental impossibility, against which mechanical ingenuity is absolutely helpless never hit them at all; and that situation has lasted from the early 70's up till today; and people are still inventing schemes of this kind.

(To be continued in the July issue of "Motorship.")



LAUNCH OF A COASTAL SUBMARINE AT ONE OF THE ANSALDO SHIPYARDS

This is a recently constructed craft and is equipped with the latest devices. For its size it probably is one of the best submersibles yet constructed. The gun mounted forward has a bore of about 3 inches.

Motorships From a Steamship Operators' Viewpoint

By BERNARD MILLS, M. S. N. A. M. E.
(Superintendent-Engineer, American-Hawaiian Steamship Co.)

To the old school operating-marine-engineer the Diesel motor is somewhat of a wonder, and is generally looked on with disfavor. Being in the above class and wishing to be convinced, I have carefully studied this motor together with its good and bad traits for the last three years, and have come to the conclusion that it, as a prime mover for marine service, has come to stay, just as the motor-car has and which can be operated by one of ordinary intelligence, so the Diesel motor will be. Right here you will say that may be; but, you can't stop a ship at sea for repairs as you do a motorcar. That is quite true, but to this the answer is that there are now in service, and have been for a number of years, more than 50 motorships of around 10,000 deadweight each in addition to many smaller vessels, most of which have been running successfully and very economically without any more delay than steamers of the same capacity. It is true that the majority of these ships are foreign, principally Swedish; but, are we of an inferior intelligence that we cannot build and operate motorships with as much success as they can?

The marine steam-engine in its infancy was looked at with as much, or more, disfavor than is the Diesel motor now; but, it won out, and the possibilities of the heavy-oil motor it seems are greater than the steam-engine. There are good and poor oil-engines as well as good and poor steam-engines, in fact a poor oil-motor is a much worse machine than a poor steam engine.

The whole oil-motor proposition hinges on a properly designed well-built plant (using the best materials for the purpose). None are too good, as temperatures and pressures are high and nothing but the best materials should be allowed to be used. It would seem that in America too many designers not being thoroughly familiar with the subject have done more harm than good in the early stages, thereby bringing disfavor on the motor, when as a matter of fact, as every one knows, any machine to do a duty as severe as is required of a motor for mercantile and naval marine service should be correctly-designed, well-built, and very carefully operated by one of intelligence, or you cannot expect good results. Owners seem too prone to look at the first cost of an installation, but to get a first class article one has to pay a good price and moreover a poor article is costly at any price. Everyone should know this, but it is only human nature to overlook this fact, which is too often done.

Let it be remembered, too, that a competent operator is a very valuable man, considering the expense and delay to a ship that a poor operator can occasion.

Coming now to the relative advantages of Diesel motors, knowing that from previous experience the experimental stage has now been passed, it is not too much to say that the degree of skill required to operate an oil-engined vessel is of no higher order than that required for a steam-engined vessel. In fact, on the whole my opinion is it is a much simpler operation, as with motors all cylinders are alike in diameter and stroke, arrangements of valves, gears, etc., and the factors governing one govern all.

Small omissions in operating motors are more serious than for steam plants generally speaking, as for instance if the piston-rings are not tight the motors lose power quickly, will not maneuver well and the high initial pressures used blow the products of combustion down into the crank-case causing trouble with the lubricating-oil, with consequent heating of and, probably spoiling the bearing surfaces, a very serious matter.

The intake, exhaust, maneuvering, and oil-injection valves should be kept in good order and tight. If not, your troubles will be many. The matter of air-compressors is another of great importance, both as regards cylinders, rings and valves. No compressor will deliver high-pressure air for any period of time without being in good order and carefully lubricated.

The lubricating system should be as near fool proof as possible, and the best grade of oil for the purpose is the cheapest in the end. Oil that carbonizes is dear at any price, it not only causes additional work for the operating engineer but the repair bills will soon tell the tale, not to mention actual delay to the ship, all of which tends to condemn the oil-motor unnecessarily.

The water-cooling system for cylinders, covers, pistons and air-compressors, etc., should be carefully looked after and circulating water kept at proper temperatures, not forgetting that an oil-motor cylinder virtually is the boiler and engine combined—the action of combustion and temperatures being very high; so if cylinder temperature is not kept within proper bounds by the cooling water, serious damage will soon be done. The journals and main bearing surfaces should be well looked to with regards to temperature and lubrication.

The matter of proper cylinder compression is one of such consequence that it means the difference between a quick maneuvering satisfactory motor and a balky and cranky one; also one that if this item is neglected leads to increased consumption of fuel.

While the steam engine is a very reliable engine for marine purposes and is more familiar to all than the oil motor, it has its shortcomings, the greatest of which is the much greater amount of fuel it requires than the oil engine to produce useful horse power at the propeller, requiring about three times as much fuel for the best designed engines.

The boilers are bulky and require constant attention, besides having to carry fresh water to feed them with. If an order comes suddenly to the engine-room for power to move the ship the motorship can be moved at a few minutes notice, whereas a steamer, depending on size and number of boilers, requires from 6 to 24 hours—a great advantage of the motorship. A steam engine can operate if one or sometimes two cylinders are out of commission—so can an oil-motor—thus there is little difference in this latter matter.

The breaking of crank-shafts, connecting-rods, piston-rods, valve rods, valves, air-pump, or compressor, and kindred troubles are equally serious either with steam-engines or motors, while the steam plant has all the ills that boilers are troubled with to be added, which are usually considerable, depending on care of operation and age. Altogether there seems to be a great deal to be said in favor of oil-motors, the greatest of which is the total benefits derived from greatly reduced fuel-consumption.

Comparing the carrying-capacity and consumption of a ship having Diesel or steam-engines, one can readily see the difference, knowing from acknowledged figures of past performances that a well designed steam engine will consume about 1 to 1.12 lbs. of oil, or 1¼ to 1¾ pounds of coal per i. h. p. per hour, and a well-designed Diesel motor about 0.30 to 0.40 lbs. of oil per i. h. p. per hour—roughly a motor-vessel can carry a given amount of deadweight at given speed three times as far as a steam vessel on the same weight of fuel.

The space given over to machinery in a modern cargo-ship will be very nearly equal for either motor or steam power, the principal advantage being part of the boiler-room length can be used for cargo in a motor-vessel and all of the fuel can be carried in the double bottom tanks, leaving the bunker-space free for cargo.

The total weight of motor machinery is about equal to steam for a given power, and in some cases less, but as no water is used for boilers this water-weight is saved and can be used for additional weight for cargo carrying.

With Diesel motors the question of boiler-room crew is entirely eliminated, which at this time is one of the greatest advantages, as everyone knows the boiler-room crew has always been the principal cause of worry to the ship's marine engineer and to the shipowner, not to mention the greatly increased number of new ships now coming from the shipyards that have to be manned up and the difficulty of getting trained firemen and trimmers.

With motors the power and speed of ship up to the maximum depends on the amount of oil fed to the cylinders and is entirely under the engineer's control and are not dependent upon moods of the firemen. The stand-by losses for motors are nil, which for vessels such as are on short runs amounts to a great deal at the end of a year. The ideal ocean-going merchant vessel is one having Diesel motor propulsion, also, using this type motor for driving electric generators for supplying auxiliary power for winches, capstans, windlasses, steering-gear, pumps, air-compressors, etc., as required.

Some argue that electrical deck-machinary subject to sea-going conditions is not practical. This again depends on the design and care of operations. We see every day trolley-cars in our city streets running through water and subject to extremely hard usage, which seems to prove that it can be done successfully. No amount of argument along any line will convince those who will not be convinced, until personal experience forces them to become convinced; but to those who will be, and are willing to bear with some delay at times (as it cannot be expected that everything will run smoothly at all times) this comparatively new motive power will soon repay amply for the time and capital invested. The present day submarines will prove to any one already unconvinced that marine oil-motors are dependable.

General Motorship and Engine News

HUGE NEW DANISH MOTORSHIP BUILDING ENTERPRISE.

A new company with a capital of twenty million guilders (about $6,000,000) has been formed to build motorships by the East Asiatic Company in co-operation with the United Steamship Company, both of Copenhagen, Denmark. The new company is known as the "New Danish Diesel Motor Shipyard" and have acquired the business and equipment of the Copenhagen Floating Dock, the Helsingors Shipyard, the Fredrikshamn Shipyard, and the Nakskov Shipyard.

At the back of this great new motorship enterprise is said to be Counsellor-of-State H. N. Andersen, who, in conjunction with other wealthy and powerful shipping and trading interests, also control the great Diesel motorship-building yard of Burmeister & Wain of Copenhagen. Burmeister & Wain are to commence the projected extension of their Diesel motorship yard this year, which addition will double the present capacity, and their main Diesel engine works have been extended ready to meet the competition of the coming years.

AMERICAN METAL PRODUCTS CO. ENTERS MARINE OIL ENGINE FIELD.

During this year we anticipated a number of new comers into the marine-oil engineering field, some to manufacture engines of there own design, others to adapt foreign experience. The most recent entry into the business is the American Metal Products Company of Chicago, Ill. In an early issue we hope to publish an article on their engines.

A 6,400 H. P. BRITISH MOTORSHIP.

There has just been completed at Glasgow the first of two marine Diesel engines of 3,200 horsepower each, which will be installed in a ship building by Harland & Wolff, at whose Diesel engine-works these motors have been under construction. They are of the Burmeister & Wain four-cycle type, built under license. When placed afloat this vessel will be the highest-powered of her class afloat.

NORWEGIAN GOVERNMENT OWNS MOTORSHIPS.

Three motorships totalling about 15,000 tons have been purchased by the Norwegian Government, and are operated by the Statens Skibsfart Direktoriat (State Ship Management Office.)

BURMEISTER & WAIN'S OUTPUT.

Owing to a shortage of material only one Diesel motorship was completed by Burmeister & Wain during 1917. However, two others have been placed in service this year.

NEW AUXILIARY LOST.

The new American-built, Norwegian-owned auxiliary-schooner "Pusey Jones I" recently foundered at sea. Her crew of ten men were picked up by a tanker.

Our Reader's Opinions

Letters of General Interest Always Are Welcome for These Columns—Editor

RE: DIESEL ELECTRIC PROPULSIVE UNITS ON MOTORSHIPS.

To the Editor of "Motorship," Sir:

THE writer has read with great interest the article above referred to, but he does not believe there is sufficient real data on the subject for any one to have a supported opinion pro or con.

There has been a number of very successful direct Diesel-driven ships, and there has been very little criticism. On the other hand, there has been a number of them that have not been very successful.

At the lower speeds, a Diesel engine is more difficult to handle than a steam engine. The Diesel engine is not always as prompt and satisfactory as in indicated in the article referred to. It does not seem to the writer that a fair trial has been made of the combination of Diesel and electric propulsion. On the face of the subject, there is very little question but that a Diesel direct drive should be the ideal condition; on the other hand, there is the objection that a Diesel engine at the slower speed and of sufficient power for the ship propulsion is very heavy, and takes up a considerable amount of space, whereas it is quite possible to produce a higher speed unit or two units with two or more electric driven shafts wherein the total weight and useful space occupied would possibly be less than in the case of the direct Diesel drive.

From what the writer knows of the subject, there has never been a real intelligently planned equipment for the Diesel electric operation, the reason for this being that in most cases the owner, without knowledge, has been allowed to have too much say in the final design of the engine room. Personally, the writer would prefer a direct Diesel propelled ship, assuming that the Diesel engine reached full perfection without too cumbersome a valve gear, and this seems to be quite a possible and satisfactory solution with more care and attention given both to the design and manufacture of these Diesel motors.

Apparently there is but one concern and one plant of that concern located in Denmark which has turned out what may be considered an absolutely satisfactory machine. The product of that same company in other plants has been reported to the writer as at times, giving considerable trouble, both in operation and inefficiency.

For this reason the writer reiterates what was said above, that there is not sufficient data for anyone to form a thoroughly comprehensive and intelligent opinion on the subject.

Yours very truly,
AMERICAN ENGINEERING CO.
G. E. SMITH, Chief Engineer.

RE SETZ ARTICLE.

Editor of "Motorship,"

Dear Sir: I have read with the greatest of interest Mr. H. R. Setz's most valuable article on marine Diesel engines in your March issue, and trust we shall see others from his pen in your very useful publication.

However, regarding the table of proposed marine engines given on page 19, I would like to know why their sizes, etc., differ so much from existing practices.

For example, take the dimensions of one of the better known European marine engines and compare two of their engines with two of Mr Setz's engines. In each case, six-cylinder, four-cycle type motors are quoted:

	Mr. Setz's Engine	European Engine
B. H. P.	1400	1400
R. P. M.	110	115
Bore and stroke	27½"x41½"	25 6/10"x43 5/16"
Weight	235 tons	190 tons
Height (O. A.)	21' 8"	?
Height from center of cranksl	?	18' 1"
Length (O. A.)	36' 9"	34' 9¾"
Diameter of crankshaft	?	15¾

or to take the case of a smaller engine, also a six-cylinder, four-cycle motor:

	Mr. Setz's Engine	European Engine
B. H. P.	800	825
R. P. M.	150	130
Bore and stroke	20¾"x31"	20½"x35½"
Weight	105 tons	96 tons
Height above center of crankshaft	?	15' 7"
Height (O. A.)	16' 2"	?
Length (O. A.)	27' 9"	25' 2⅝"
Diameter of crankshaft	?	12⅝"

From these figures, it would appear that Mr. Setz's proposed engines would not be nearly as efficient as those of European make quoted above. Perhaps Mr. Setz can explain.

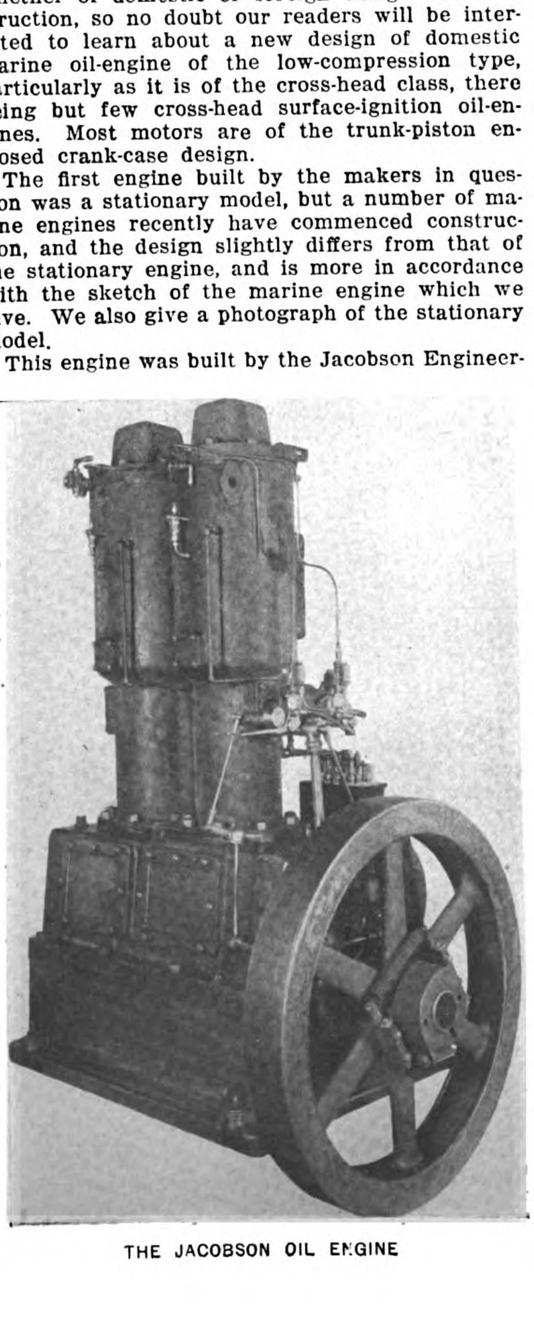
Yours very truly,
MARINE ENGINEER.

NEW CROSS-HEAD TYPE SURFACE-IGNITION OIL-ENGINE

AT all times there is a certain amount of interest displayed in new marine oil-engines whether of domestic or foreign design and construction, so no doubt our readers will be interested to learn about a new design of domestic marine oil-engine of the low-compression type, particularly as it is of the cross-head class, there being but few cross-head surface-ignition oil-engines. Most motors are of the trunk-piston enclosed crank-case design.

The first engine built by the makers in question was a stationary model, but a number of marine engines recently have commenced construction, and the design slightly differs from that of the stationary engine, and is more in accordance with the sketch of the marine engine which we give. We also give a photograph of the stationary model.

This engine was built by the Jacobson Engineering Co., Saratoga Springs, N. Y., U. S. A., and was particularly designed with a view to giving heavy-duty and continuous service. Its cycle of operation is practically that of the ordinary two-cycle oil-engine, with the main difference that crank-case compression is dispensed with. The engine is fitted with cross-head and piston-rods and the cylinder is similar to the double-acting marine steam-engine; but the lower part of the cylinder is used for the compression of air for scavenging the combustion chamber.



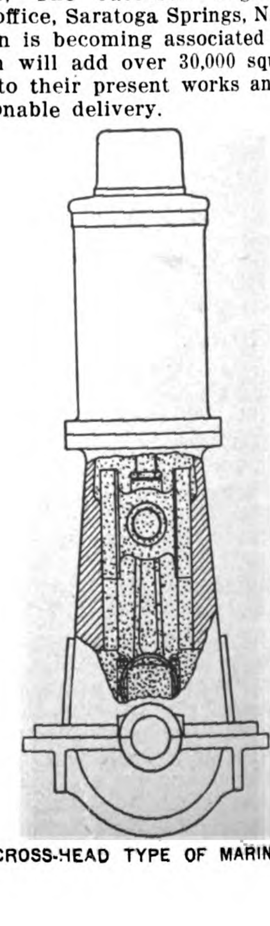
THE JACOBSON OIL ENGINE

The ignition is of the hot-surface type, and, say the makers, the careful design of the ignition-head insures regular explosions even at light loads. In fact the engine can be run for hours at no load without the heads cooling-off sufficiently for engine to miss fire. Starting of this cross-head type is by air. With a two-cylinder engine starting is arranged to operate on only one cylinder, which requires but a small air-compressor unit and small air-storage bottles. The method of starting is as follows: The wheel is barred around until the piston in the air-starting cylinder is just past dead center. When the engineer is ready to start he injects fuel-oil into each of the cylinders by a hand priming lever shown at the fly-wheel and of the engine; and then manipulates the quick opening air-valve which admits the air under pressure to the cylinder, and an explosion results which gives the engine its first impulse. Then in rotation the piston compresses the air charge in the cylinder and fuel is injected so that the engine assumes its regular cycle of operations. The engine is fitted with fly-wheel governor which acts positively and thoroughly on the fuel injection by shortening the pump-strokes and so prevents any over-speeding or racing of the engine. A single hand-lever operated by the engineer controls the fuel, so that any speed may be maintained from a light-load to full-load speed for which the governor is set.

The main feature which the designer considers insures reliability of this engine for long continuous service is the oiling system. A sketch with the crank-case broken open to show the oiling of the head slide, etc., is shown. Stipling represents oil in the crank-case. The lubrication of the main bearings, crank pins, cross-head slides, pins and piston rods are supplied by splash and requires no attention beyond adding a little oil occasionally to that in the base. The lubrication of these working parts is carried out by being showered in a constant spray or mist of lubricating oil which is free from carbon or any injurious gritty particles from the cylinder.

The McCord mechanical force-feed lubricator gives reliable and economical lubrication of the cylinders. After the lubricator is properly adjusted the engineer need only fill the lubricator tank when it needs replenishing. This oil is fed in just the right quantities and insures enough for the cylinder lubrication and does not mix with the oil in the crank-case at all. With the cross-head type there is no difficulty encountered with lubricating oil-vapor being drawn in with the scavenging-air as quite often occurs in the crank case compression type. This the builders believe is one very bad feature of heavy-duty crank-case type two-cycle engines. Furthermore there should be no trouble with leakage of compression since there is but one soft steam engine packing around the piston-rod which has to withstand a pressure of only a few pounds so that it is subject to practically no heat.

The Jacobson Engineering company will manufacture low-compression marine oil engines from 10 b. h. p. upwards in standard sizes in both enclosed design, cross-head and crank-case compression design, and will build 1,000 h. p. engines in 8 cylinders. Any reader of "Motorship" who is interested may obtain full particulars in regard to sizes, constructional details, etc., from the builders, The Jacobson Engineering company, main office, Saratoga Springs, N. Y., U. S. A. This concern is becoming associated with a new plant, which will add over 30,000 square feet of floor space to their present works and so should insure reasonable delivery.

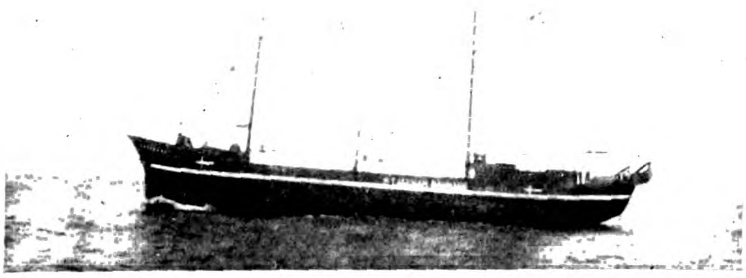


JACOBSON CROSS-HEAD TYPE OF MARINE OIL ENGINE

SOUTHERN BUILT MOTOR AUXILIARIES.

RECENTLY the Government referred to the excellent progress recently made with wooden shipbuilding in the South; and elsewhere in this issue, we are giving some excellent illustrations of motor driven auxiliaries under construction at one well-known Southern yard. We are enabled to give on this page photographs of two more auxiliaries recently built in the South. These are of the "Stjarnan" and "Pensacola," two wooden vessels constructed by T. T. Bingham at Pensacola, Fla.

The "Stjarnan" was built for an Iceland owner, and is of 575 tons d. w. c. She is constructed of live-oak, and long leaf yellow pine, with galvanized iron fastenings. For auxiliary propelling power, she has two 45 b. h. p. Fairbanks-Morse heavy-oil marine engines of the surface-ignition type. Under her official trial trip the "Stjarnan" averaged 7.3 knots. She flies the Danish flag. Her length is 135' by 30' breadth and 10' molded depth.



MOTOR AUXILIARY "STJARNAN"

The "Pensacola" is a slightly larger ship, being of 700 tons d. w. c., and has been purchased by the French Government. She is built of similar materials. Her auxiliary power consists of two 60 b. h. p. Fairbanks Morse heavy-oil marine engines. On her trial trip the speed attained was 8 knots.

Now under construction at the same yard is an auxiliary motor schooner of 350-tons d. w. c. This vessel will have in proportion, a larger sail area, and a single propeller driven by a 65-75 b. h. p. Standard (of N. J.) gasoline engine of the electrical ignition type equipped with a kerosene vaporizing device. A speed of 6½ knots is expected, and the launching will take place in August next. All Mr. Bingham's ships are launched 100 per cent complete.

SHIP-OPERATING POLICY OF THE U. S. SHIPPING BOARD.

Some months ago "Motorship" discussed the question of planning and arranging for after-war world-wide commerce and trade in co-operation with carrying out war work, and indicated why it is imperative that shipowners shall be given back their vessels upon cessation of hostilities, and that after the war the Government should cease to be an operator of ships unless it is to subsidize and finance private shipowning interests.

During last month Mr. E. F. Carry, head of the Division of Operations of the Shipping Board made the following statement:

"The policy of the Shipping Board is to give every legitimate assistance towards the building up of operating companies in order that these will be ready to handle the great fleets which the government will turn back to commerce upon the coming of peace. As rapidly as they can be completed, new vessels are turned over to existing operating companies to replace vessels which the Shipping Board had requisitioned for war needs. While it is obvious that these should be favored first, the Shipping Board wishes it to be made known that it will encourage the formation of new operating companies if such companies can give satisfactory evidence of financial probity and practical experience in the shipping business."

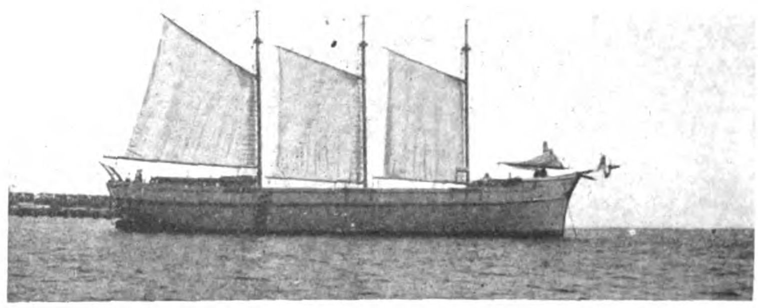
This policy would seem to be a wise and udicious one; but, it remains for the authorities o arrange terms with the shipowners whereby hey receive reasonable compensations for their ervices. Furthermore, the authorities must enure that the ships now being built are of such a ype and construction whereby they can be profitbly operated against foreign economical motorhips, after the war. Otherwise shipowners are ertain to decline the ships, with thanks, leaving the Government saddled with a huge fleet of merchant vessels that can only be run at a loss in competition with foreign craft on the high seas. At the same time we now feel confident that the Emergency Fleet Corporation will build the right kind of ships.

INCREASES TO ITALIAN MOTORSHIP YARDS.

For the purpose of increasing the size of their steel and wood Diesel motorship building yards, large orders for machinery will be placed by the Fiat-San Giorgio of Turin, Italy, with American manufacturers in the near future. Preliminary inquiries have already gone out to producers of machinery and full specifications are on the way from Italy. The Fiat-San Giorgio shipyard, which is controlled by Gio. Ansaldo & Co., and which was described in "Motorship" of April, will be enlarged by building six, or more, ways for the can manufacturers include shears, punching machines, lathes, milling, drilling, and grinding machines, as well as straightening and bending rolls, and cranes of various types.

SIX-HUNDRED TON CONCRETE MOTORSHIP.

The largest concrete motorship yet built was launched on March 11 at the Fougner yard, Moss, Norway. Previous reference has been made to construction of 8,000-ton cargo motorships. It is designed to operate these boats with Diesel oil-burning engines manufactured by the company. A testing-shop up to 6,000 h. p. will also be built. The machine tools to be purchased from America this vessel, which is 145 ft. long by 27½ ft. beam, and 15 ft. 9 in. molded depth. The propulsion power is furnished by a 320 h.p. Bolinder surface-ignition type of reversible oil-engine.



TRE AUXILIARY "PENSACOLA"

LARGE CHINESE CONCRETE MOTORSHIP.

There recently has commenced construction a reinforced concrete American-Diesel driven motorship at Saigon, Cochin-China, French Indo-china, of 2,200 tons d.w.c. This vessel is being built at the yard of the Societe Indochinoise de Constructionis Navales, and will be powered with two direct-reversible, four-cycle type McIntosh Seymour Diesel-type oil engines.

She is of special interest for two reasons. First, she is one of the largest motor-driven ships of concrete construction yet laid down; secondly, a new type of construction is involved by which a weight similar to that of a steel ship of the same characteristics is expected. She will be ready for launching about August next, and the trial trip should be run about November, the engine set not yet having been shipped. Her length is 270 ft. x 38 ft. beam and 18 ft. draught.

CONCRETE TUGS.

Two tugs of concrete construction are on order with the Fougner Concrete Shipbuilding Co., who have acquired the Ray shipyard at Bowery Bay, North Beach, Long Island, N. Y. It is probable that oil-engines will be installed in these craft. They also will build a 112x30 barge for the Standard Oil Company, but no power will be installed.

AMERICAN 4,000 H.P. MARINE DIESEL ENGINE

We hear that the marine Diesel engine which the Bethlehem Steel Company are developing is a unit of a—or a complete—4,000 b. h. p. engine of the valve-scavenging, two-cycle type; but this is not authentic. It will be most interesting to see what results are obtained with this valve-scavenging motor, especially as our British contemporary recently pointed out that valve-scavenging has been almost universally abandoned for marine work. Maybe our good friend, Mr. Arthur West, has something up his sleeve which will create a stir when details are made public. He is one of America's best internal-combustion engineers.

THE MOTORSHIP "LARA" AND THE MOTORSHIP "JUNO."

The builders of the Diesel machinery of the motorship "Lara" and of the motorship "Juno" have received splendid verbal reports regarding these single-screw ships, which recently cruised to Singapore without any mishaps, also other Werkspoor-engined motorships owned by the Asiatic Petroleum Company regularly are doing admirable work without any serious hitch. We have written for further details concerning the operations of these Diesel-driven vessels to Mr. Mulder, Marine Superintendent, Asiatic Petroleum Company, Singapore, Dutch East Indies.

ANOTHER DUTCH STEEL AUXILIARY LAUNCHED.

The three-masted steel motor-schooner "Maria," building at the Wilmink yard, Holland, for the Neerlandia Co. of Amsterdam, has recently been launched. She is propelled by a 130 b.h.p. Steywal heavy-oil engine. The "Maria" is of 500 tons d.w.c.

NEW 9,500-TON MOTORSHIP "BONHEUR."

One of the motorships of the new fleet of Mr. Fred Olsen of Christiania, Norway,—the "Bonheur,"—was launched recently at the Burmeister & Wain yard at Copenhagen, Denmark. This steel, Diesel-driven vessel is of 9,500 tons dwc. and her oil-engines are of the direct-reversible, four-cycle class. The same shipyard also have completed the oil-engined collier "Rash," a craft of 2,475 tons gross register, and owned by the Copenhagen Bunker Coal Company.

A CORRECTION.

Through a typographical error the lubricating-oil consumption of the Tosi 1300 b.h.p. four-cycle type submarine engine was given in our March issue as 0.0334 lbs., and that of the two-cycle engine as 0.0180 lbs. These figures should have been reversed, the two-cycle engine having the larger oil consumption.

TRIAL TRIP OF THE "LEADER."

Accompanied by many friends, Frank B. Peterson made an initial cruise about the bay on April 15 in the new tender "Leader," just completed at the Stone Shipbuilding yards, Oakland, for his company. The run is reported to have been satisfactory in every way. The new tender is 70 feet in length, and 15 feet of beam. She is powered with one 110 b.h.p. Union gas engine, and is rigged with two masts, and with rigging to spread mainsail, staysails and jib. The "Leader" will start for her station at Naknek under her own power in a few days from the time of writing. The first run will be to Ketchikan, where the supply of fuel will be replenished and a start made for the station in the far north.

Activities of the Gulowsen Grei Engine Company

Long Established Firm of Oil-Engine Builders to Have a Large and Well Equipped Factory

A NEW and important addition to the oil-engine industry of the United States is the Gulowsen Grei Engine Company, which has within the last two months gotten well under way at Seattle, Washington. A large and suitable site for their factory, with excellent rail and water facilities has already been purchased upon which a modern factory is now in the course of construction. It is the intention of the new company to have finished, ready for delivery, their first engine by the first part of 1919 and thereafter to turn out 15,000 b. h. p. per year.

The Gulowsen Grei Engine Company is the outgrowth of the Gulowsen Engine Company of Christiania, Norway, which has been manufacturing oil-motors of marine and stationary types in that country since 1893 and which has an annual capacity for approximately 20,000 b. h. p., being the largest oil-engine establishment in Norway. The parent factory founded by Anders Gulowsen has for many years been evolving an engine which has now reached a high state of perfection and which has gained an enviable reputation amongst users of internal-combustion engines on the continent. Their success seems to have reached America some time ago for Mr. Gulowsen has been in receipt for the last few years of a great number of inquiries from prospective users of oil-engines in the United States and Canada, and it was on account of the rapidly growing interest in this region that Mr. Gulowsen was prompted to undertake a visit here, the announcement of which appeared in the April number of Motorship.

Almost coincident with the appearance of their announcement Mr. Gulowsen and his factory manager, O. C. Rossoe arrived in New York City with the intention of investigating the oil-engine field in this country and of determinig whether their company would be warranted in manufacturing their engine here. After going over the situation very carefully they came to the decision that a very favorable opportunity did exist for the manufacture and sale of an engine such as theirs. They visited practically all the important manufacturing points in the United States considering the while the manufacturing facilities and market conditions of the different localities. The last place they visited was Seattle where they found that although manufacturing facilities were not so favorable as in some places they had visited nevertheless the propinquity to the Pacific Coast fishing industry more than over-balanced this temporary disadvantage.

A company was incorporated under the name of the Gulowsen Grei Engine Company, and under the laws of the State of Washington with a capital of $560,000; the names of the incorporators being Anders Gulowsen, O. C. Rossoe, and R. A. Rossoe. The trade name of their engine is to be "Gulowsen Grei," and is to be both marine and stationary.

ANDERS GULOWSEN

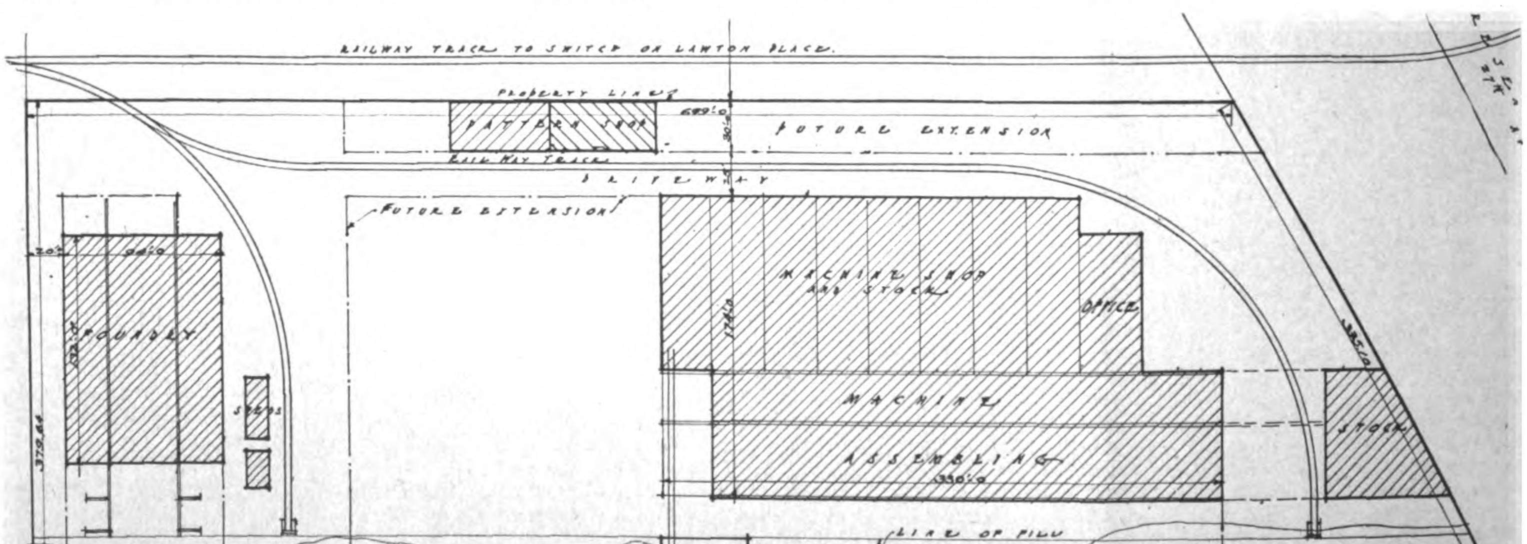
Founder of the Gulowsen Engine Company of Christiania, Norway, and President of the Gulowsen-Grei Engine Company of Seattle, U. S. A.

Plans for a modern factory were drawn up and an excellent site of six acres fronting on the new United States Government Canal at Salmon Bay was chosen, upon which the construction of the various buildings is now being rushed. Machine tools to the amount of nearly $200,000 have been purchased so that when the plant is completed more than $350,000 will have been spent. In placing orders for tools Mr. Gulowsen was aided by his knowledge of and friendly relations with American manufacturers, for the home factory in Norway is fitted throughout with American machine tools, for which he has a high regard.

The buildings which are to be built immediately and their respective sizes are: Office building, 45'x80'; machine shop No. 1, 30'x255'; machine shop No. 2, 60'x100'; assembling shop, 44'x255'; test room, 45'x70'; foundry, 94'x132', pattern shop, 30'x100', and the stock room for the finished product which is at the south end of the machine shop and assembling shop. There is further, a repair shop, toolroom, blacksmith shop, hardening and heat treating department, stock rooms for rough and semi finished parts and an up-to-date wash room for the workmen. The flooring will consist of concrete, covered with 3" planking. A spur of the Union Pacific R. R. enters the yard at the north end and from this spur will be built two more, one to serve the foundry and the other to serve the stock and storerooms. Additional rail facilities have been provided between the different buildings in the form of intercommunicating rails upon which small work cars will be operated. From the accompanying plot plan a very good idea as to the general arrangement of the yards and buildings can be gained.

Some of the larger tools for which orders have been placed are the following: 1 Dill 15" Slotter, 1 No. 2 Van Norman "Duplex" Miller and extra equipment 1-60"x60"x15' Ingersoll slab miller, 1-24"x96" Norton Grinder for grinding the crankshafts. The orders for which were placed with Manning Maxwell & Moore's local representative. The Perine Machinery Company of Seattle received orders for a large assortmetnt of tools among which were 2-48"x24' American heavy-duty engine lathes, 3-24"x12' American heavy pattern lathe, 3-18" and 3-16" American lathes, 1-No. 2A Warner and Swasey geared head turret lathe, 1-6' American plain radial drill, 1-5' full Universal radial drill and various other tools of various sizes such as Surfacers, Sanders, Embossing machines, shapers, mortisers, lathes and drills. The Hallidie Machinery Company of Seattle, Wash., received orders for numerous tools, also among which may be mentioned the following: 1 Heald Style 16" Rotary Surface Grinding Machine, 1-36" Bullard Vertical Turret Lathe, 1-No. 3 Cincinnati plain high power and 1-No. 3 universal power milling machines, 3-20"x12" and 2-20"x14" Lodge & Shipley selective head engine lathes, 1-Landis horizontal boring, drilling and milling machine. A 24" Steinle full swing side carriage turret lathe, a Conradson 42"x36"x8' heavy multispeed planer was among other tools placed with L. G. Henes Company of San Francisco. From this list a general conception of the size and quality of equipment to be installed can be gleaned.

The Gulowsen Grei Engine is of the vertical two-cycle surface ignition type and runs in powers from 4 to 250 b. h. p. They are built in two types: Type "G" a heavy-built and slow running

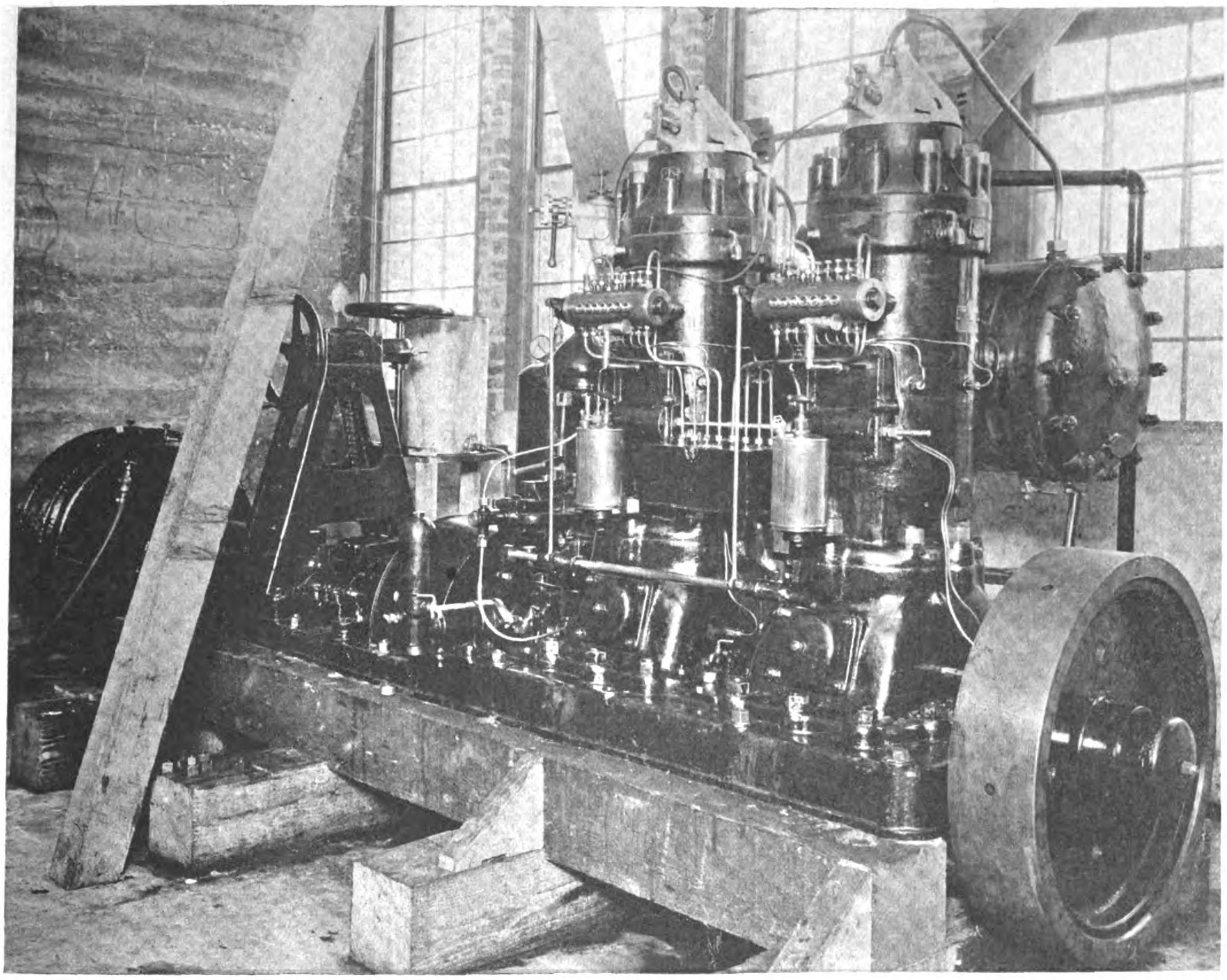


GOV CANAL AT SALMON BAY

PLOT PLAN OF THE GULOWSEN-GREI ENGINE COMPANY AT SALMON BAY, SEATTLE, WASH.

model and type "H," one of medium weight and moderate speed. All sizes except the 4 h. p. size, which will only run on kerosene, is constructed so as to burn kerosene or crude oil with a specific gravity of from .80 to .92.

The Gulowsen Grei engine is easy to operate, efficient and requires very little attendance. The hot bulb is heated by a blow torch requiring but from eight to twelve minutes to heat the bulb sufficiently to ignite the mixture. The larger governor on direct reversible engines.) An important feature on this kind of engine is that in maneuvering of the ship there is no chance for the engine to stop due to cooling off of the hot bulb; the Gulowsen engine is able to run as well with as without load and is guaranteed to run idle any length of time and pick up at once the load is thrown on. The fuel consumption when idling is extremely low. The engine runs as well with as without water drip. The water drip will versing gears can also be used if desired, but the company recommends the reversible propeller on all engines up to 130 h. p. The reversing column is located very conveniently at the rear end of the machine on the engine frame. It is operated by a hand wheel in a similar manner as the clutch which is hand operated and also conveniently located at the rear part of the engine. A clutch is provided which is operated by hand with very little effort. The cylinders, pistons, crank-



This protograph, which was taken in the display rooms of the Gulowsen-Grei Engine Company, shows a 100 b. h. p. motor of their design which was built in Norway and brought to the United States for display purposes. Readers will note on the extreme left of the protograph the water brake directly connected to the crankshaft, and also the force-feed lubricators located one on each cylinder.

sizes are started with compressed air and the smaller sizes by hand. While running it does not require the torch as the hot bulb on account of its special construction retains the heat created by the explosions. The engine is flexible and vibrations are reduced to a minimum; one of the things which make for the reduction of vibration is the accurately counter-balanced crankshaft. A speed governor of the centrifugal type controls the fuel injection, making the fuel consumption low (the Gulowsen engine is as far as we know the only one using the centrifugal type of increase the power of the engine about 15 per cent and also decreases the amount of fuel per horse power hour. For marine purposes the complete propeller equipment for engines up to 130 h. p. will be manufactured by the company and will be mostly of the reversible type, which construction has been perfected by this company. It is the ideal propeller for tug boats and fishing boats, which require instantaneous control of the speed of the boat at all times. Engines from 50 h. p. and up are also made direct reversible, using propellers with fixed blades. Reshafts and a number of the main parts are accurately ground to limit gauges. The main crankshaft bearings are line-reamed and afterwards hand-scraped; considerable care being taken to insure perfect bearing surface. The wrist pin is hardened and ground and run in adjustable phospher bronze bearings which can be adjusted for wear in the same manner as the crankshaft bearings.

A 100 b. h. p. motor of the marine type is now on display at the display rooms of the company, 2523 Western Avenue, Seattle, Washington.

HAS THE AUXILIARY MOTORSHIP PROVED ITSELF?

From time to time the question, "Does the Motorship Pay?" agitates the minds of those who are interested in maritime matters. The large, full-powered European motorships are universally recognized as successful in every way; but, many do not mean such vessels, which they say are really "steamships," when they refer to motorships. It is the auxiliary schooner which uses sails as well as engines that some say is doomed to go. The fact that the number of these vessels is constantly increasing seems to make no impression on some owners or naval architects; they still insist that the propellers and engine are a detriment rather than an aid to speed in such schooners.

The career of the "Annie Johnson" should convince these doubters. The schooner "Annie Johnson" was built a good many years ago and about two years ago she was fitted with twin 160 h. p. Bolinder fuel-oil engines. Before her engines were placed she averaged six round trips per year between San Francisco and Honolulu. Last year she made nine round trips. On her last trip to the islands she left San Francisco on March 2 and arrived on March 14. On her return she left on the afternoon of March 30 and arrived in her home port on the morning of April 13. Thus her running time on the round trip was less than 26 days. In fact, for the past two years she has made the trip in from 12 to 14 days.

Compare these figures with the time taken by vessels depending solely on sail power and the auxiliary-powered schooner at once justifies itself. The "Falls of Clyde," rated high as a sailing ship, left for Hawaii at the same time as the "Annie Johnson" left and arrived there four days later. On her return trip "Falls of Clyde" left the islands on March 23 and was still at sea on April 16. Another ship, which is rated high in San Francisco, the "Marion Chilcott," left San Francisco on March 8 and arrived at Hawaii on April 6. These examples are taken as they were at sea the same time that the "Annie Johnson" was and encountered comparably the same conditions. If increasing the mileage of a vessel by 50 per cent is an advantage, the auxiliary motorship has proved its case in the "Annie Johnson."

DENMARK HAS NEARLY 500 MOTORSHIPS.

There were four-hundred and eighty-eight motorships aggregating 97,316 gross tons (about 180,000 tons d. w. c.) in the Danish mercantile fleet on January 1st, 1918, according to Commercial Agent Norman L. Andersen. Of course, he says, 55 vessels of 80,200 gross tons have Copenhagen as their port of registry. This compares with 464 motorships of 95,024 gross tons on Jan. 1st, 1917.

Obviously, 433 of these craft must be fishing boats, tugs, and other small commercial craft, as their average dead-weight-capacity is only about 70 tons. However, 55 motorships averaging about 2750 tons d. w. c. each in addition, is no mean "little fleet," for such a small country. On Jan. 1st, of this year, Denmark had 538 steam-driven ships of 577,882 gross tons aggregate.

We do not know if Mr. Andersen's figures are officially accurate, but we are very much inclined to think that they can be relied upon as the East Asiatic company of Copenhagen owns 15 motorships of 120,000 tons capacity.

The White Diesel Engine

A British-Built Marine Heavy-Oil Engine of Which a Number Have Been Built for the British Admiralty

WHILE the war has been in progress not a little attention has been given to developing and constructing the marine type of Diesel engine in Great Britain, especially for naval purposes, and after hostilities have ceased it may be found that Britishers have done quite a considerable amount of work along that particular line of engineering.

The British Admiralty have not hesitated to purchase the Diesel engines of Allied and Neutral countries for various classes of craft during this critical period. Some British firms have been building oil-engines almost solely for naval purposes, and others merely have been experimenting with mercantile engines during odd available moments for the purpose of becoming fully prepared for after-war trade and production, thus keeping in step with many other branches of the engineering industry, which also are bearing in mind that preparation is of importance, ranking next to that of winning the war. Countries which the war leaves unprepared commercially will be in a worse position than if Germany had conquered them. This, we must not lose sight of!

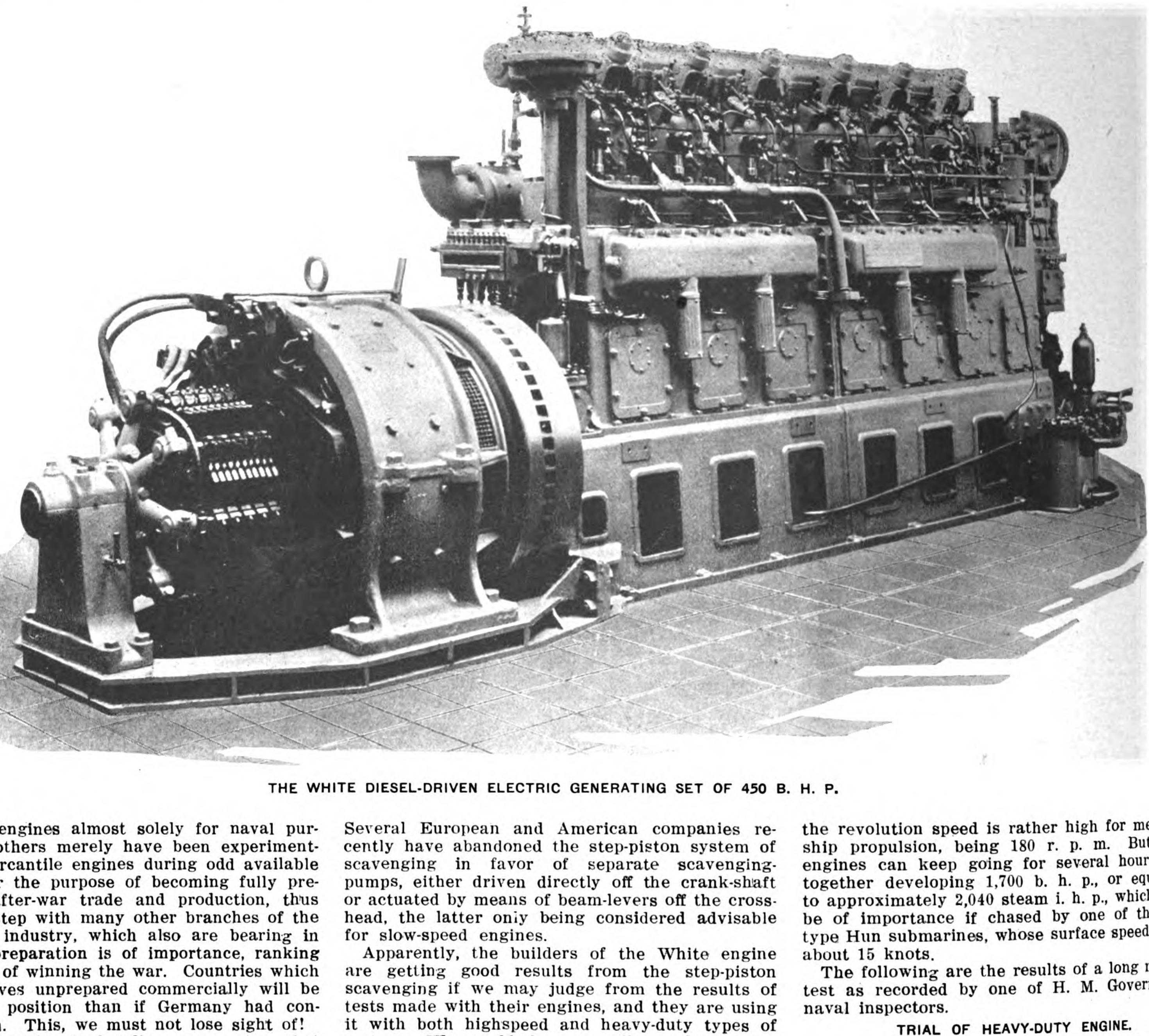
Among British shipbuilding companies that have devoted considerable time, money, and energy to the development of both mercantile and naval types of Diesel engines, are Messrs. J. Samuel White, of Cowes, Isle of Wight, who perhaps are better known as builders of torpedo-boat-destroyers. Also in the early days of aeroplaning they actively took up the construction of sea-planes, little realizing at that time that flying-boats so soon would be used in active warfare. They also were among the first of English shipbuilding concerns to take up marine heavy-oil-engine construction, and in the initial days acquired a Nürnberg license from the M. A. N., so that their engines resemble in a number of ways, the engine which was built by the New London Ship & Engine Co., of Groton, Conn., before the latter changed to their own four-cycle design. Messrs. White, of course, did not strictly follow the Nürnberg design; but, as time went by made minor changes in accordance with the teachings of their own experiences. They also took up the Brons oil engine, but, whether they have produced the latter engine commercially we have not any knowledge.

The Diesel engine which they have adopted is of the step-piston type; that is to say the lower part of each piston is of larger diameter than the upper section and is used for the purpose of compressing air to a few pounds per square inch for scavenging the burned gases from the combustion chambers, there being no separate exhaust stroke with the two-cycle Diesel engine; nor is there any crank case compression for that purpose. Several European and American companies recently have abandoned the step-piston system of scavenging in favor of separate scavenging-pumps, either driven directly off the crank-shaft or actuated by means of beam-levers off the cross-head, the latter only being considered advisable for slow-speed engines.

Apparently, the builders of the White engine are getting good results from the step-piston scavenging if we may judge from the results of tests made with their engines, and they are using it with both highspeed and heavy-duty types of motors. We would, however, like to have from them a little more information concerning their experiences with this particular part of the design, and such would be of great interest to American engineers who have noted what has been done by several other builders of step-piston engines, and naturally desire to "get at" the real facts. Information of this sort will do much to aid the general development of the marine heavy-oil internal-combustion-engine.

We are enabled to give test results of an engine of the heavy-duty merchant-ship type built by Messrs. White for the British Admiralty, and we believe, is one of the pair installed in the naval tanker "Turmoil," a vessel 280′ long, by 39′ beam and 23½′ molded depth and 12½ knots loaded-speed, built at the Royal-Pembroke Dockyard. Possibly, however, the engine of which we give trials may be one of a number of similar power installed in a more recent motorship built for the Admiralty. We are advised that repeat orders are now under construction, so evidently the British Navy soon will have some additional motor tankers. Details of nine existing ships already have been given in "Motorship" for January last.

Each engine is direct-reversible and has six cylinders, 14½" bore by 24" stroke, and weighs complete about 157,500 lbs. (70¼ long tons.) Incidentally it will be noticed that compared with steam-engines, boilers, condensers, and boiler-water, a great saving in weight is shown, as the two Diesel engines together represent an equivalent of about 1,850 steam indicated horsepower yet they only weigh about 140 tons, although of course the revolution speed is rather high for merchant-ship propulsion, being 180 r. p. m. But, these engines can keep going for several hours when together developing 1,700 b. h. p., or equivalent to approximately 2,040 steam i. h. p., which might be of importance if chased by one of the older type Hun submarines, whose surface speed is only about 15 knots.



THE WHITE DIESEL-DRIVEN ELECTRIC GENERATING SET OF 450 B. H. P.

The following are the results of a long non-stop test as recorded by one of H. M. Government's naval inspectors.

TRIAL OF HEAVY-DUTY ENGINE.

Mean power developed	756 B. H. P.
Mean speed	181 R. P. M.
Rated speed	180 R. P. M.
Duration of trial (non-stop)	96 hours
Fuel-oil used per B. H. P. per hour	0.467 lb.
Lubr. Oil used per B. H. P. per hour	0.0125 lb.
Fuel used	Texas crude oil
Scavenger-air pressure	6.5 lbs.
Lubricating and oil cooling pressure	25. lbs.
Exhaust	Perfectly clear
Lowest smooth running speed of engine	55 R. P. M.
Weight of complete engine per B. H. P.	195 lbs.

After opening out and inspected, the engine was run for a further period of 2 hours developing 850 b. h. p. without any signs of overloading. After this trial the engine was ready for service without any further adjustments or alterations.

That greater strides constantly are being made with the two-cycle type of engine will be seen from the fuel consumption, which is 0.467 lb. per b. h. p. hour, compared with about 0.390 to 0.410 lb. for the best four-cycle practice, although 0.380 lb. has been recorded with the Sabathé type of submarine oil-engine in naval tests.

In view of these results no doubt trials of a higher-speed light-weight type of naval engine, also built by Messrs. White for the British Admiralty, will be of considerable interest. This engine, while of the submarine type, apparently was built for electric-lighting on a battleship, or other naval vessel, and it is coupled to a generator. Sets of this design have been in continuous service for three years.

It is of the six-cylinder, non-reversing, step-piston, two-cycle type, 11" bore by 12" stroke and rated to develop 450 b. h. p. at 450 revolutions per minute.

When a specially light type of engine is required, such as for small submarine-destroyers or other fast surface-craft, this weight can be reduced, also in proportion in powers up to 1,600 shaft horse power per engine. This may indicate that Messrs. White have built, or are prepared to build, light-type Diesel engines of this high power.

We now will give a general description of the Diesel engines built by Messrs. White and which are constructed in two different types, as just intimated, and are built in sizes from 150 b. h. p. to 1,600 b. h. p.

The heavy, slow-running, types are for mercantile marine and land installations; and there are units of 175 b. h. p., 250 b. h. p. and 750 b. h. p. in service and repeat orders under construction. The light type high-speed engines are for special service including submarines.

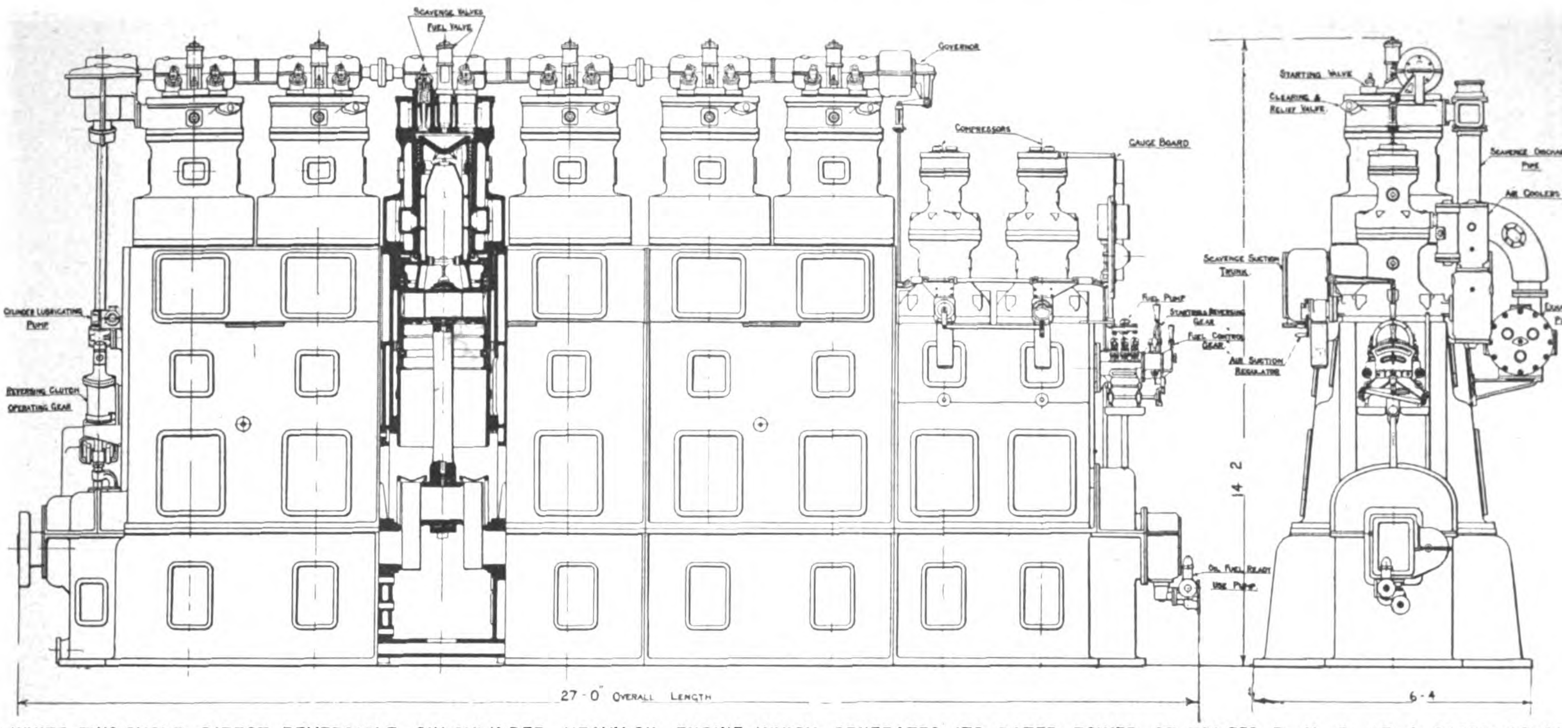
All the marine engines are directly reversible, and can be reversed from full-ahead to full astern in a few seconds. Starting and reversing gears are simple in design, efficient, and readily accessible; and it is worthy of special note that the full-speed revolutions can be reduced at least one-third in number for slow running when cruising speeds are desired.

Forced-lubrication is used throughout for all the principal bearings and also utilized for the cooling of the piston-heads. With the larger powered engines the piston-cooling arrangement is separate and distinct from the general system.

All operate on the two-stroke cycle, have a uniform turning moment—thus obviating the fitting of flywheels for the marine units—are carefully balanced to reduce vibration to a minimum. Furthermore all working parts are constructed to gauge limits so are interchangeable.

The pistons are of the stepped-type with removable heads for easy replacement, in case of cracks, etc., the scavenge-air piston being a part of the main cylinder piston—which arrangement has the advantage of removing the crosshead from the hottest part of the cylinder, as in the case of other designs of engines of this type; the stepped-piston also acts as a guide for the crosshead, thereby removing the thrust load from the working piston. This, Messrs. White claim, obviates troubles obtainable with other types of engines.

The working-cylinders are separate and distinct and interchangeable, are made of the best cast-iron obtainable. Separate cylinder covers are provided which can be quickly removed for inspection. Each cover carries the fuel-valve and scavenge-valves with their respective cams and air-starting gear. The fuel-injection air-compressors are arranged at the starting and forward end of the engines and are of special design—the outcome of years of experience, and are said to be efficient and quiet running.



THE WHITE TWO-CYCLE, DIRECT REVERSIBLE, SIX-CYLINDER, HEAVY-OIL ENGINE WHICH GENERATES ITS RATED POWER OF 750-850 B. H. P. AT A SPEED OF 180-210 R. P. M.. SIZE OF CYLINDERS 14½ in. by 24 in.

TRIAL OF NAVAL TYPE ENGINE.

Mean B. H. P.	415 R. P. M.
Revolutions per minute	402 R. P. M.
Rated speed	450 R. P. M.
Duration of trial (non stop)	72 hours
Fuel used per B. H. P. per hour	0.536 lb.
Lubr. oil per B. H. P. per hour	0.029 lb.
Fuel used	Texas crude oil
Scavenger air pressure	7 lbs. per sq. in
Exhaust	Perfectly clear
Lubricating and cooling-oil pressure	22 lbs. per sq. in.
Lowest smooth running speed of engine	125 R. P. M.
Weight of complete engine per B. H. P. at 450 B. H. P.	65 lbs.
Weight of complete engine	13½ long tons

After opening out and inspection the engine was run for a further period of 4 hours at 450 b. h. p. without any signs of overloading and this engine we are advised is now on service in the same condition as when it left their works.

THE CONCRETE SHIP "FAITH."

The "Faith," the largest concrete ship yet built, arrived at Seattle, Wash., from San Francisco, Calif., May 29, after going through one of the most severe gales ever experienced on the Pacific Coast. It was the maiden voyage of this vessel and her performance on the trip has been watched by everyone interested in marine matters, not the least concerned of which was the United States Shipping Board, who had special investigators and surveyors make the trip to make their own investigations and draw their own deductions. The trip was a success in every way and the "Faith" fulfilled the faith of the builders, the San Francisco Shipbuilding Company, in every particular. Tersely summed up, Capt. R. E. Connell, formerly of the Luckenbach Steamship Company, in charge of the vessel on the trip, made the following statement: "She acted just like most any other vessel and responded readily to her helm throughout the entire voyage, during which time we had some very rough weather and some very fine weather. She certainly stood the test."

When the "Faith" docked she was boarded by representatives of the American Bureau of Shipping, United States Inspector of Hulls, Capt. Wm. Fisher, officials of Balfour, Guthrie & Co., the charterers, and many shipping men from many points on the Pacific Coast. All of these people after an inspection are ready to bear out the statements of Capt. Connell that she is "a first class sea-going ship."

F. R. McMillan and H. S. Loeffler, research engineers of the Emergency Fleet Corporation, and C. C. Brush, of the United States lighthouse service, representing the concrete ship department of the United States Shipping Board at Washington, accompanied the "Faith" on her maiden voyage but the reports made by them will not be submitted to the public before being presented at Washington. Continuous stress records were taken at various points of the ship by means of recording strain gauges designed especially for the purpose. The seas encountered were very heavy and afforded a good opportunity to study the action of the reinforced concrete hull under conditions ordinarily expected in service. In the opinion of these men the trip was very successful and the indications are all very favorable toward the success of concrete ships. Further than voicing opinions such as these, these men refused to give comment.

The plans of the builders of the "Faith," now that that vessel has demonstrated her practicability, are definitely laid for the building of many more vessels. The new ships to be built will be of 7,500 tons d. w. c., be 100 feet longer and have a beam 13 feet wider and will be able to make more than 10 knots, the speed of the "Faith" under normal conditions. The engines of the new ships will be placed amidships instead of aft, as in the case of the "Faith." A new design will be followed which before its adoption will be submitted to the Shipping Board and government advisors will be on the job supervising the construction of the vessels.

GERMAN MOTORSHIP CONSTRUCTION.

For the purpose of mainly building motorcraft the shipyard of F. Lomn, at Boitzenburg, Germany, has been enlarged. Last year they completed the Diesel-driven motorship "Fiemmo," a vessel of 600 tons d. w. c.

Before the war the following German shipyards completed large Diesel-driven motorships, and they recently have increased their capital:

	Marks.		Marks.
Blohm & Von, Hamburg	12,000,000	to	20,000,000
Reiherstieg Co., Hamburg	5,000,000	to	6,000,000
J. Frerichs Co., Einswarden	2,000,000	to	4,500,000
J. L. Tecklenborg Co., Geestemunde	4,000,000	to	6,000,000

This means a total increase of 14,000,000 marks for the four yards. The Weser Co. of Bremen another motorshipbuilding concern, have increased their capital to 7,300,000 marks.